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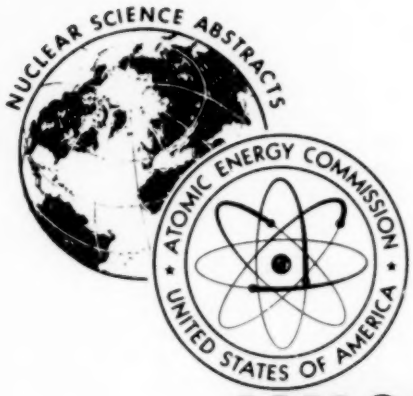

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Volume 16, Number 9 May 15, 1962

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

9729 (ASD-TR-61-60) SIMPLIFIED METHOD FOR PREDICTING THERMAL RADIATION IN THE VICINITY OF NUCLEAR DETONATIONS. Paul L. Vergamini (Dayton, Ohio. Univ. Research Inst.). Feb. 28, 1961. Contract AF33(616)-7017. 34p. (AD-262643)

Simplified, empirical equations are presented which allow determination of the incident thermal radiation on a receiver in the vicinity of a nuclear detonation. The equations are essentially curve fits to the thermal energy values calculated by the Chapman and Seavey prediction technique for both ground and air bursts and for a variety of atmospheric and geophysical parameters. The simplified equations correlate very well with the thermal energy data obtained during OPERATION REDWING. The thermal energy equations for the specific type days standardized by the Air Force in their nuclear weapons capabilities studies are included in the report. Sample calculations employing the simplified equations are presented in Appendix A and a summary of the pertinent equations is given in Appendix B. (auth)

9730 (CEX-60.6) EXPERIMENTAL EVALUATION OF THE RADIATION PROTECTION PROVIDED BY AN EARTH-COVERED SHELTER. Z. Burson and H. Borella (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Apr. 1961. Contract [AT(29-1)-1183]. 43p.

A study was undertaken to determine the protection against fall-out radiation provided by an earth-covered shelter. The study indicated that the shelter offered excellent protection from fall-out radiation deposited on and around the shelter. This study also added additional data to the research in radiation shielding provided by various structures which is being conducted by the Civil Effects Test Operations, Division of Biology and Medicine, U. S. Atomic Energy Commission. A fall-out radiation field was simulated by pumping, at constant speed, a sealed Co^{60} source through a long length of tubing which was evenly distributed over an area. Radiation measurements were made inside the shelter by dose-integrating ionization chambers. In general, the results indicated that the protection factor (ratio of the open-field exposure dose rate to the exposure dose rate in the structure) was approximately 5000 in the center of the shelter, increasing to 10,000 to 15,000 along the sides, and decreasing to about 3000 near the ends. Directly below vents the protection factor was found to be approximately 2500 at the 3-ft level. The shelter was a half-round corrugated-steel structure covered by a minimum of approximately 2 ft of earth on the top and 5 to 7 ft of earth on the sides. (auth)

9731 (NP-11357) NRL QUARTERLY ON NUCLEAR SCIENCE AND TECHNOLOGY. Progress Report, October–December, 1961. (Naval Research Lab., Washington, D. C.). Jan. 1, 1962. 15p.

The results of research on strangeness and the group-space of the proper Lorentz group are summarized. The coordinates of the Bethe-Heitler bremsstrahlung formula are changed to permit a more exact numerical integration for photon spectra. The ionization which thermionic electrons may produce in the emitter's own vapor was studied. The general approach being followed in the construction of a high-voltage, high-current pulser (modulator) for a 1000-ampere electron gun is outlined. (D.L.C.)

9732 (SC-4645(RR)) INSTRUMENT CANISTER RECOVERY. Final Report. E. S. Ames (Sandia Corp., Albuquerque, N. Mex.). Jan. 1962. Contract [AT(29-1)-789]. 12p. Project COWBOY.

This report is a Supplement to SC-4470(RR).

A description is given of the recovery of Cowboy-type instrument canisters from the Carey salt mine, where they had been for 18 months. Procedures used to correct cable and cannister sealing problems are also described. (auth)

9733 (SCR-214) INTERPRETATION AND PREDICTION OF RADAR TERRAIN RETURN FADING SPECTRA. Progress Report No. 2. Peter D. Welch (New Mexico Coll. of Agriculture and Mechanic Arts, State College. Physical Science Lab.). July 1960. For Sandia Corp., Albuquerque, N. Mex. 52p.

Reprinted from AER-18B, dated Feb. 15, 1956.

Activities are reported in a program to investigate aspects of extending the theoretical fading spectra calculative schemes to nonhorizontal flight paths. Work on analyzing the effect of post-detection integration on both the fading spectra and the d-c/a-c ratio is also reported. (J.R.D.)

9734 (TID-5059(5th Rev.)) CORPORATE AUTHOR ENTRIES USED BY THE DIVISION OF TECHNICAL INFORMATION IN CATALOGING REPORTS. Everett J. Hoffman, ed. (Division of Technical Information Extension, AEC). Feb. 1962. 144p.

9735 (UCRL-5973-T) NUCLEAR EXPLOSIVES AS APPLIED TO MINING AND MINERAL INDUSTRIES. David D. Rabb (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 7, 1959. Contract [W-7405-Eng-48]. 8p.

Presented at the National Western Mining Conference of the Colorado Mining Association, Denver, Colorado, February 7, 1959.

Results are reviewed for 9 underground nuclear test explosions that have resulted in a wealth of data and information that prove that radioactivity and radioactive fall-out

can be completely controlled, that seismic effects are relatively minor, that appreciable amounts of heat and shock are generated, that this power may be utilized to serve a useful purpose, and that debris in an explosion area can be worked soon after the detonation. The phenomenology of nuclear explosions underground and energies released per kiloton of explosive are discussed. Possible scientific and industrial applications of underground nuclear explosions are considered. (C.H.)

9736 (JPRS-11811) THE SHOCK WAVE OF AN ATOMIC EXPLOSION. I. A. Naumenko and I. G. Petrovskii (Petrovskiy). Translation of p.3-160 from "Udarnaya Volna Atomnogo Vzryva" (a publication of the Military Publishing House, Ministry of Defense, Moscow, 1956). 170p.

A translation is presented of a Russian book, The Shock Wave of an Atomic Explosion. A general description of atomic weapons is followed by a description of the appearance of a shock wave in the air after an explosion. Topics discussed include the interaction of shock waves with an obstacle, the effect of weather conditions on the propagation and action of a shock wave in air, shock waves in water from underwater atomic explosions, blast waves in the ground, the damage effect of a shock wave, the effect of a shock wave from an atomic explosion on personnel and on different types of structures, and protection against shock waves in air. It is concluded that atomic weapons will not decide the outcome of battles. Success will be achieved by the skillful use of all available arms. The intensity of military operations is increased when atomic weapons are used. Fortified works constitute a good means of defense against an atomic explosion and all should be equipped in accordance with the requirements of antiatomic defense. (C.H.)

9737 TRANSIT OF PRESSURE WAVES THROUGH NEW ZEALAND FROM THE SOVIET 50 MEGATON BOMB EXPLOSION. E. Farkas (New Zealand Meteorological Service, Wellington). Nature, 193: 765-6(Feb. 24, 1962).

The times of passage are tabulated for the first, second, and third pressure waves in the atmosphere from the Soviet 50-megaton explosion on Oct. 30, 1961, and recorded on New Zealand barographs. The arrival times are consistent with the passage of the first wave from the northwest, the second from the southeast, and the third from the northwest. The average speed of the pressure waves was calculated to be 306 m/sec. (D.L.C.)

9738 ATOMIC ENERGY IN ITALY. Nuclear Power, 7: No. 70, 51-78(Feb. 1962).

The development and use of atomic energy for constructive purposes in Italy is discussed with respect to the progress being made and the programs being actively pursued. The topics discussed and outlined include: economic aspects, power reactor development, industry's contribution, legal aspects, reactor safety supervision, the Italian Nuclear Forum, liability and insurance, research programs, activities of organizations and companies, Italy's contribution to nuclear technology, and training of nuclear engineers. Special interest is also given to the design aspects of the Garigliano nuclear power station, design improvements of the SELNI station, and construction work of Latina station. (N.W.R.)

9739 GENERAL ASSEMBLY OF THE DIVISIONS OF THE ACADEMY. Vestnik Akad. Nauk S.S.S.R., 31: No. 12, 67-93(Dec. 1961). (In Russian)

B. P. Konstantimov stated that electrostatic forces play often an important role in the interplanetary space as was recently proven by data obtained by the American satellites concerning the galactic cosmic ray spectra. Electrostatic interaction may also intervene in the statistical mechanics of the formation of accelerated particles in cosmic rays. B. B. Kadomtsev discussed the stability of plasma in magnetic fields. This problem is important not only for the confinement of high-temperature plasma but also for the explanation of oscillation phenomena. More than ten types, such as the magneto-hydrodynamic, convection and current-convection types of instabilities are known today, presenting certain analogy with the instability observed in unevenly heated gases in a gravity field. This may help to develop a better picture of the nonlinear turbulence of plasma motion resulting from the instability and to explain the anomalous diffusion of plasma across the magnetic field. N. M. Sisakyan pointed to the biological problems involved in the peaceful application of atomic energy and to the newly opened field of cosmic biology for solving problems involved in space flight. (TTT)

9740 ATOMIC ENERGY LEGISLATION THROUGH 87th CONGRESS, 1st SESSION, JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES. (United States. Congress. Joint Committee on Atomic Energy). Dec. 1961. 278p. $0.75(GPO).

The Atomic Energy Act of 1954, all amendments, statutes, and legislation through the 87th Congress, First Session, are presented. Appended are the Atomic Energy Act of 1946, as amended, an index to legislative history of the Atomic Energy Act of 1954 and amendments, an index to legislative history of the Atomic Energy Act of 1946 and amendments, and cross reference charts for the Atomic Energy Acts of 1946 and 1954. (C.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

9741 (AERE-R-3839) MEDICAL LABORATORY EXAMINATIONS. COLLECTED LABORATORY PROCEDURES. C. Sanders (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Sept. 1961. 82p.

Brief descriptions are presented for the various routine laboratory procedures and methods of recording the results used in the clinical laboratories of the medical division. Most of the methods described have been subjected to detailed experimental work and statistical analysis in order to assess sources of error and their cumulative magnitude. Mechanization has been introduced where possible to eliminate some of the more tedious procedures. (C.H.)

9742 (BNL-5879) STUDIES ON THE APPLICATION OF THE COULTER ELECTRONIC COUNTER IN ENUMERATION OF PLATELETS. Clyde R. Sipe and Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). [1961]. 18p.

Presented at New York Academy of Sciences Conference on Application and Methods of Counting and Sizing in Medicine and Biology; Nov. 29, 1961.

The use of the Coulter Blood Cell Counter for counting of platelets in the blood is discussed. Threshold settings for counting separated platelets were determined and coincidence error was calculated. A method was developed for separation of platelets from red cells. Anticoagulant fixatives were developed that prevented adhesion and fragmentation of the platelets. A practical clinical method for platelet counting is outlined. (M.C.G.)

9743 (NP-11305) REPORT OF OBSERVATIONS [ON] NUTRITION: RADIATION AND STERILIZATION OF FOODS FOR AUBURN UNIVERSITY, AUBURN, ALABAMA. M. A. Ross (Armed Forces Inst. of Pathology, Washington, D. C.). Sept. 15, 1961. 16p.

A histopathologic review of material from dogs that had been maintained on a diet containing irradiated codfish or sweet potatoes revealed no evidence of any change that could be attributed to the specific food or level of irradiation. (C.H.)

9744 (TID-14952) THE USE OF POSITRON EMITTING ISOTOPES IN THE LOCALIZATION OF INTRACRANIAL LESIONS. Period covered: May 15, 1961–February 14, 1962. J. Donald McQueen and John L. Mego (Baltimore. City Hospitals). Feb. 14, 1962. Contract AT(30-1)-2182. 23p.

The results of clinical data on the intra-arterial injection technique include scanning tumor depictions from 19 patients who had both intravenous and intracarotid injections of positron-emitting As^{74} arsenate. The findings indicated that fractional intra-arterial injections may be used to significantly lower the patient dosage and to increase the legibility of tumor images. The technique was of real value only for patients harboring intrinsic tumors. However, fractional injections did not fail diagnostically when administered inadvertently to patients with meningiomas because of the avid isotopic uptake by these tumors. It was also found that the dosage for routine intravenous injection (in tumor suspects without indication for early angiography) could be satisfactorily reduced to 750 μc. As^{74} sodium arsenate, As^{74} arsanilic acid, and As^{74} azoproteins were injected into tumor-bearing mice for evaluation as possible tumor-localizing agents. Tumor to brain ratios for As^{74} arsenate were about 8:1 and for As^{74} arsanilate about 16:1 (1 hr. after injection). The uptake of As^{74} arsanilate was about one-third less than that of As^{74} arsenate. The enhanced tumor to brain ratios obtained with arsanilate appeared to be due to a decreased uptake in brain tissue. The As^{74} azoproteins contained either 8, 5, or 1-2 molecules of As^{74} arsanilate per molecule of protein. Preliminary results indicated that more extensive labeling results in more rapid disappearance from the blood stream, greater accumulation in kidney and liver, and less uptake in tumor. Tumor to brain ratios obtained with the less extensively labeled material averaged about 20 to 40:1 and were maintained for at least 48 hr. (auth)

9745 (TID-14965) BIOLOGICAL, CHEMICAL AND RADIOCHEMICAL STUDIES OF MARINE PLANKTON. REFERENCE NO. 62-4. Bostwick H. Ketchum (Woods Hole Oceanographic Institution, Mass.). Feb. 15, 1962. Contract AT(30-1)-1918. 15p.

Progress on field investigations and laboratory experiments on marine plankton biology is reported. Four cruises were made to study the waters between Woods Hole, Mass. and Bermuda. The geographical distribution of both phytoplankton and zooplankton including their vertical distribution in the water column was studied along with the chemistry of the water. (M.C.G.)

9746 (TID-14965(App.)) BIOLOGICAL, CHEMICAL AND RADIOCHEMICAL STUDIES OF MARINE PLANKTON. APPENDIX TO REFERENCE NO. 62-4. Progress Report, January 1 to December 31, 1961. (Woods Hole Oceanographic Institution, Mass.). Feb. 15, 1961. Contract AT(30-1)-1918. 204p.

Ten completed manuscripts on biological, chemical, and radiochemical studies of marine plankton are given. Topics covered include: adsorption of phosphates onto bubbles; copepods collected by the nuclear submarine Seadragon to and from the North Pole; abundance, seasonal occurrence, and distribution of the epizooplankton between New York and Bermuda; organic sources of nitrogen for marine centric diatoms; regeneration of nutrients; rate of phosphorous uptake by Phacodactylum tricornutum; nitrate measurements in the presence of high nitrite concentrations; autotrophic nitrification in the ocean; measurement of visible light absorption by particulate matter in the oceans; and opening-closing devices for plankton nets operated by pressure, electric, and mechanical stimulus. (M.C.G.)

9747 (TID-14999) ATTEMPTS TO DELINEATE INBORN ANEMIAS IN MICE. Progress Report, February 1, 1961–January 31, 1962. Elizabeth S. Russell and Seldon E. Bernstein (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Jan. 31, 1962. Contract AT(30-1)-1800. 18p.

Results are reported from extensive investigations of the etiology of three different types of hereditary anemia in the house mouse. Studies of W-series macrocytic anemia include tests of potentialities and limitations of therapy through implantation of normal blood-forming tissue; detailed studies of contrasting reaction of normal and anemic mice to radiation damage; reaction of normal and anemic mice to different erythropoietic stimuli and to plethorization; and search for metabolic error in hematopoiesis through isotopic-labeling studies of the kinetics of heme synthesis in normal and genetically anemic mice. Studies of Sl-series macrocytic anemia include characterization of effects of a new viable allele (Sl^d); attempts at therapy through

implantation; and studies of reactions of viable anemic mice to erythropoietic stimuli and to x irradiation. Similarities and differences between results with the two genetically distinct macrocytic anemias may provide valuable clues as to the gene-actions involved. Studies of the transitory siderocytic anemia of ff mice, based on a new homozygous inbred stock (FL/Re), include detailed characterization of the anemia and its effects on growth in fetuses and newborn mice; tests of effects of single-gene substitutions (Ww, Ff, and FF) on this syndrome; and search for evidence of metabolic error in FL/Re mice. The previous finding of effects of single-gene substitutions on acute radiosensitivity is being followed up by a more extensive study of the effects of single doses of a wide range of deleterious genes affecting hematopoietic tissue. Studies of the nature and mechanism of action of a specific radiation protection factor are continuing. Additional areas of investigation include characterization of new hereditary anemias as they arise and preparation of controlled genetic stocks for further study of such new material. (auth)

9748 (UCRL-9897) BIOLOGY AND MEDICINE SEMI-ANNUAL REPORT, FALL 1961. John H. Lawrence, ed. (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1961. Contract W-7405-eng-48. 229p.

Included are 25 papers concerned with research studies in biology and medicine. Separate abstracts have been prepared for 23 papers. (B.O.G.)

9749 (UCRL-9897(p.1-26)) CHEMICAL ELEMENTS OF THE BLOOD OF MAN. J. W. Gofman, O. deLalla, et al. (California. Univ., Berkeley. Lawrence Radiation Lab.).

A discussion is given of the evaluation of the x-ray emission spectroscopy method for the elemental analysis of human blood serum. Included are the results for the determination of 40 elements from phosphorus to uranium in ppm for the 20 to 22 subjects measured showing the individual values, the mean value, the standard deviation of the distribution, the measured standard error of estimate, and the standard counting error. (B.O.G.)

9750 (UCRL-9897(p.27-30)) MEASUREMENT OF SERUM ORGANICALLY-BOUND IODINE BY NEUTRON ACTIVATION. T. R. Manney, G. LaRoche, et al. (California. Univ., Berkeley. Lawrence Radiation Lab.).

A discussion is given of the development of a glass apparatus for the separation of the iodine-128 from the neutron activated serum, and a system for counting the iodine-128 activity which is proportional to the iodine-127 initially in the serum. These developments make possible a procedure that is both rapid and simple while offering promise of dependability. Problems regarding quantitation remaining in the procedure are discussed. (B.O.G.)

9751 (UCRL-9897(p.31-40)) ALPHA PARTICLE PITUITARY IRRADIATION IN ACROMEGALY. J. H. Lawrence, C. A. Tobias, et al. (California. Univ., Berkeley. Lawrence Radiation Lab.).

A discussion is given of the observations made of the effects of alpha particle irradiations of the pituitary gland in sixteen patients with acromegaly and two patients with chromophobe adenoma. (B.O.G.)

9752 (UCRL-9897(p.41-51)) PITUITARY IRRADIATION OF PATIENTS WITH METASTATIC CARCINOMA OF THE BREAST: ESTROGEN STUDIES. A. S. Cleveland, J. H. Lawrence, et al. (California. Univ., Berkeley. Lawrence Radiation Lab.).

A discussion is given of the observations made in the study of the urinary estrogen titer in 35 patients with advanced metastatic mammary carcinoma before and after receiving pituitary irradiations. The observations of the estrogen levels are tabulated for pre-menopausal with oophorectomy, pre-menopausal without oophorectomy, post-menopausal with oophorectomy, and post-menopausal without oophorectomy. Estrogen pre-irradiation values are listed for patients with and without remission. The effects of an intramuscular injection of testosterone on urinary estrogens is illustrated in a patient with advanced metastatic mammary carcinoma, five years after pituitary irradiation. The estrogens isolated to date from human urine are tabulated. (B.O.G.)

9753 (UCRL-9897(p.52-65)) THE EFFECTS OF LONG-TERM ADMINISTRATION OF P^{32} IN CHRONIC LYMPHOCYTIC LEUKEMIA. R. C. Steinkamp, J. H. Lawrence, and J. L. Born (California. Univ., Berkeley. Lawrence Radiation Lab.).

A discussion is given of the observations of the effects of long-term administrations of phosphorus-32 on 161 patients with chronic lymphocytic leukemia (CLL). Survival times were calculated from onset of symptomatology or diagnosis in asymptomatic cases, diagnosis, and first visit to Donner Laboratory. Analysis of symptomatology, physical findings, and laboratory data at the time of diagnosis indicated that there is no absolute measure for prognosis. No cases of acute leukemia were observed nor was the incidence of malignancies increases as a result of the treatment. Hemolytic complications tended to occur in those patients in whom the course had been long and slowly progressive. Subjective and objective improvements occurred in those patients treated with oral androgens. The important conclusion from the study reemphasizes the fact that the diagnosis of CLL can be compatible with many years of useful life and should bring reassurance to both the doctor and patient that the disease follows a relatively benign course in an appreciable number of cases. (B.O.G.)

9754 (UCRL-9897(p.66-83)) RADIATION-INDUCED OXIDATION OF PROTEIN IN AQUEOUS SOLUTION. W. M. Garrison, M. E. Jayko, and W. Bennett (California. Univ., Berkeley. Lawrence Radiation Lab.). (UCRL-9813).

A discussion is given of the development of an approach to the study and measurement of radiation-induced modifications in the co-valent structures of proteins. The reactions considered are largely those of the N-C bond which, in its various chemical forms, represents the single most characteristic configuration of protein structure. The basis of the approach to the elucidation of the mechanism in the radiolysis of oxygenated solutions of protein is that reactions at the loci of N-C linkages may be generalized in terms of the over-all equation: $(R)_2N\text{-}CH(R)_2 + O_2 + H_2O \rightsquigarrow (R)_2NH + RCOR + H_2O_2$, where $(R)_2N\text{-}CH(R)_2$ represents any of the variously substituted primary, secondary, and tertiary amino configurations of protein molecular structure. Regardless of the type or extent of substitution, a reactive carbonyl function is obtained as one of the products of the reaction, and the nature of the N-C linkage specifies the chemical form of the nitrogen-containing product. (B.O.G.)

9755 (UCRL-9897(p.84-90)) COMPARISON OF THE EFFECTS OF WHOLE-BODY X IRRADIATION AND FASTING ON THE PLASMA LIPIDS OF MICE. C. S. Rehnborg, J. K. Ashikawa, and A. V. Nichols (California. Univ., Berkeley. Lawrence Radiation Lab.).

This information is also contained in UCRL-9849.

A discussion is given of the observations of the fatty acid distribution of the plasma lipoprotein lipids in male Swiss Webster and Namru mice at various times after exposure

to a 2000 r whole-body lethal amount of x rays, and in non-fasting and 24-hr fasting Swiss Webster mice. The data indicates that the decreases in the low density lipoprotein (LDL) concentration in the irradiated and fasting mice are of the same order of magnitude. The high density lipoprotein (HDL) response is divergent and shows, during fasting, a definite increase in concentration and an alteration in fatty acid composition. It is noted that although the LDL concentrations decrease after a 24-hr fast, the significant increases in HDL lead to either net increases or no change in total plasma lipid concentrations. The present results are consistent with observations describing marked elevations in phospholipids in albino mice in the first 5 days of fasting. (B.O.G.)

9756 (UCRL-9897(p.91-5)) ELECTRON MICROSCOPY OF CHYLOMICRONS. T. L. Hayes, F. T. Lindgren, and J. C. Schooley (California. Univ., Berkeley. Lawrence Radiation Lab.). (UCRL-9684).

A discussion is given of the results of an electron microscopy study of chylomicrons, that consist primarily of triglycerides, in human serum and in lymph from the thoracic duct of rats. A synthetic vegetable oil emulsion was used as a source of non-chylomicron triglyceride particles. Micrographs are included showing the isolated chylomicrons from the human serum and the rat lymph, and the lipid particle from the emulsion. (B.O.G.)

9757 (UCRL-9897(p.96-102)) TRANS ISOMERS OF UNSATURATED FATTY ACIDS IN SERUM LIPIDS AND BODY FAT OF HUMAN BEINGS. N. K. Freeman (California. Univ., Berkeley. Lawrence Radiation Lab.).

A discussion is given of the observations made in the infrared spectroscopy of fatty acids of serum lipids and body fats of humans. Spectrographs are included of the spectra of some fats in carbon disulfide solutions from 8 to 14.5 μ. The results of the measurements of the cis and trans isomers of the unsaturated fatty acids are tabulated. (B.O.G.)

9758 (UCRL-9897(p.103-18)) A MODEL OF CROSSING-OVER APPLICABLE TO TETRAD ANALYSIS. R. A. Gilmore and R. K. Mortimer (California. Univ., Berkeley. Lawrence Radiation Lab.).

In an attempt to account for the discrepancy in the Barratt Model concerning the tetratype frequencies, a more general model was proposed that incorporates sister-strand exchanges and also considers chromatid interference. The model is of additional interest because of its bearing on the proposal that all non-sister exchanges are two-strand and that three- and four-strand multiples result from sister exchanges along with the two-strand non-sister exchanges. The basis assumptions employed in the derivation are: crossing-over occurs at the four-strand stage, successive crossovers occur serially along the segment in question, and chiasma interference is taken into consideration on the basis that sister strand exchanges when present are equivalent to non-sister exchanges. Some other definitions used in the model are that adjacent non-sister exchanges are distributed in the ratio p : r : q with respect to 2-, 3-, or 4-strand involvements, and that for any crossover, sister-strand exchanges occur with a frequency α and non-sister exchanges with a frequency $(1-\alpha)$. (B.O.G.)

9759 (UCRL-9897(p.119-23)) STIMULATION OF THE MOTOR CORTEX OF THE RAT BY PULSED ACCELERATED BEAMS OF HEAVY IONS. C. A. Tobias, J. Luce, et al. (California. Univ., Berkeley. Lawrence Radiation Lab.).

A summary is presented of the status of studies of the stimulation of the cerebral cortex of rats. The method used in the studies is outlined. Among the responses observed are motion of a single whisker while other whiskers remained stationary, hind-leg movement together with independent stimulation of a fore-leg movement, motion of the entire side of the face, irregularities in the breathing rate of the animal while the beam was on usually resulted in more rapid and deeper breathing, and convulsion of the abdomen or irregular contractions of the abdomen were elicited repeatedly while the beam was on. (B.O.G.)

9760 (UCRL-9897(p.125-30)) REMOVAL OF CEREBRAL CORTICAL TISSUE WITH MINIMAL SCAR FORMATION IN MONKEYS. D. Van Dyke and P. Janssen (California. Univ., Berkeley. Lawrence Radiation Lab.).

The study was made to determine whether an α-particle beam could be used to excise cortical tissue without subsequent scar formation in the monkey as in the rat. The preliminary results were similar to those obtained in rats, with two differences. In the monkey the irradiated dura and arachnoid were replaced by dense fibrous tissue, whereas in rats the necrotized dura was replaced by an essentially normal-appearing dural membrane, even though the size of the irradiated area was the same for both, and the process of healing in monkeys was found to take more than 200 days, whereas the healing in the rat was completed in a few weeks. The area of necrosis produced by the α-particle beam was found to have exceedingly sharp boundaries both at its edges and particularly at the base of the lesion; the tissue being either destroyed completely or uninjured. That the sharpness of the boundaries is the important factor in preventing glial proliferation is only speculative, but it is conceivable that glial proliferation occurs primarily in areas of partial injury, areas of partial injury being essentially eliminated by means of this type of irradiation. (B.O.G.)

9761 (UCRL-9897(p.131-3)) PROTON ACTIVATION IN SPACE VEHICLES. C. A. Tobias and P. Todd (California. Univ., Berkeley. Lawrence Radiation Lab.).

Eleven proton reactions were studied for aluminum-27, carbon-12, nitrogen-14, and oxygen-16, and the initial specific activities of the products of each reaction are presented as calculated from equations based on a single radial traverse of the inner Van Allen belt. A discussion is given of the application of the results to some practical problems of space flight and exploration. It is concluded that the radiation resulting from proton activation of items in space vehicles in the inner Van Allen belt is small but measurable under some circumstances. In the discussion no consideration is made for shielding or for the occurrence of solar flares. (B.O.G.)

9762 (UCRL-9897(p.134-43)) AN INTRAVASCULAR POLYSACCHARIDE ASSOCIATED WITH TOTAL-BODY IRRADIATION: OCCURRENCE AND SIGNIFICANCE WITH SYSTEMIC AND GASTRO-INTESTINAL BETA RADIATION. H. S. Winchell, A. C. Andersen, and M. Pollycove (California. Univ., Berkeley. Lawrence Radiation Lab.).

A study was made of the role of the gastro-intestinal mucosa in the production of intravascular polysaccharides-(IVS) from a comparison of the capacity of total-body β radiation with that of orally-administered Y^{90} used as the β emitter on a group of 42 dogs. Evidence is presented that following systemic Y^{90}-DTPA irradiation petechial hemorrhage in the dog is associated with the presence of IVS rather than thrombocytopenia. Significant quantities of IVS are not present after destruction of colonic mucosa by β irradiation but are present after comparable destruction of small bowel mucosa. Radiation pathology observed after

$Y^{90}Cl_3$ administered orally differs from that following oral administration of Sr^{90}-Y^{90} equilibrium mixtures and comparable local intestinal mucosal damage at a much higher dose range when using Y^{90} alone as compared to Sr^{90}-Y^{90}. (B.O.G.)

9763 (UCRL-9897(p.144-6)) SYNERGISTIC ACTION OF X IRRADIATION AND ELEVATED TEMPERATURES ON DEVELOPMENT. M. Amer and J. V. Slater (California. Univ., Berkeley. Lawrence Radiation Lab.).

A study was made of the effects of x irradiation at 1200 r and incubation temperatures of 30 and 38°C on the production of abnormalities in the development of Tribolium. The observations of the effects are given graphically as the per cent abnormalities occurring as a function of time following irradiation in days. (B.O.G.)

9764 (UCRL-9897(p.147-50)) DOMINANT LETHALITY IN YEAST: LET STUDIES WITH THE LRL HEAVY ION LINEAR ACCELERATOR. L. R. Adams (California. Univ., Berkeley. Lawrence Radiation Lab.).

A study was made to determine the efficiency of various linear energy transfers (LET) for helium, neon, carbon, and boron ions for the production of dominant lethal changes. Survival curves were plotted for each type ion and for the 50-kv x rays. The inverse of the 50% survival dose was taken as an arbitrary measure of the sensitivity, which was then plotted as a function of the LET of the radiations used. The data shows that the carbon ions, with a LET of 1875 Mev/g/cm^2, are the most efficient for the effect considered. It can be assumed that, at higher LET's there is an excess of ionization with regard to that needed for effect, and that the efficiency, or sensitivity, should drop off for higher LET's, as is indicated in the case of neon for a LET value of 5700 Mev/g/cm^2. (B.O.G.)

9765 (UCRL-9897(p.151-8)) COMPARISON OF RETENTION AND ORGAN DISTRIBUTION OF Am^{241} AND Cf^{252} IN MICE; THE EFFECT OF IN VIVO DTPA CHELATION. H. G. Parker, A. deG. Low-Beer, and E. L. Isaac (California. Univ., Berkeley. Lawrence Radiation Lab.).

The study was undertaken to determine the retention and organ distribution of californium-252 and americium-241 in mice, and the effectiveness of DTPA chelation therapy in removing the isotopes from the body. No significant fluctuations in weight occurred during the period of study, and at autopsy, no gross abnormalities were observed. At 4 days, 96% of the Am-241 and 95% of Cf-252 were absorbed by the control animals, and these values were not increased at 14 days. The liver was found to be an important initial site of deposition of the isotopes, and that both have a rapid rate of turnover from the liver, which was borne out by the early high rate of fecal excretion. Skeletal activity of untreated animals shows a net increase in Am-241 and a net decrease in Cf-252 between the 4th and the 14th days, while the loss of Am from the liver is ~3 times that of Cf. The animals receiving DTPA showed very little deposition of either isotope in the liver at 4 days and none at 14 days. DTPA tends to prevent the incorporation of the isotopes in bone and also enhances their rate of removal from the bone. (B.O.G.)

9766 (UCRL-9897(p.159-64)) DETERMINATION OF REGIONAL BLOOD FLOW IN GASTROINTESTINAL TRACT OF INTACT ANIMALS. M. Bacaner and M. Pollycove (California. Univ., Berkeley. Lawrence Radiation Lab.).

A radioisotopic technique is described which was devised to study regional circulation in the gastrointestinal tract as applied to the descending colon using a P-32 beta emitter. The counting was made by a colon probe centered in a series of calibrated concentric cylinders containing aliquots of a P-32 solution. 73% of the maximal counting rate of the radioactivity was found within 1 mm of the probe surface, while 94% was found within 4 mm of the probe. The results of studies of the effects of local arterial occlusion, hemorrhage, local venous occlusion, and saline infusion on the blood flow in the colon are given graphically. (B.O.G.)

9767 (UCRL-9897(p.165-70)) EXISTENCE OF AN ERYTHROPOIETIC LABILE IRON POOL. M. Pollycove and M. Maqsood (California. Univ., Berkeley. Lawrence Radiation Lab.).

A study was made of some of the iron kinetics components in dogs and rabbits to demonstrate the existence of an erythropoietic labile iron pool. The data on rabbit erythrocytes and canine marrow indicate that a labile erythropoietic iron pool exists on the membranes of immature erythrons, and that this iron is derived from plasma transferrin bound iron and transfers back to plasma, as well as transferring irreversibly into erythrons for heme synthesis. (B.O.G.)

9768 (UCRL-9897(p.171-7)) CIRCULATORY STUDIES OF PATIENTS WITH POLYCYTHEMIA VERA. P. M. Weber, M. Pollycove, et al. (California. Univ., Berkeley. Lawrence Radiation Lab.).

An examination was made of the relations between the red cell volume and the blood viscosity found in patients with polycythemia vera which suggest the possibility of deciding whether variations in cardiac output and stroke volume occur as functions of hematocrit and blood volume. The study demonstrates that patients with polycythemia vera have a lower cardiac output and lower stroke output than normal individuals with the same blood volume. The turnover of blood volume per minute is less, and consequently the circulation is slower than in normal individuals. A direct correlation between blood volume and cardiac output predominates slightly over other factors affecting cardiac output. At a given blood volume, an inverse correlation exists between hematocrit and cardiac output. (B.O.G.)

9769 (UCRL-9897(p.178-87)) IMMUNOCHEMICAL STUDIES OF HUMAN URINARY ERYTHROPOIETIN. J. C. Schooley and J. F. Garcia (California. Univ., Berkeley. Lawrence Radiation Lab.).

The immunological study was made to determine a useful approach toward the identification and removal of contaminants present in human urinary erythropoietin. Rabbits were immunized against concentrates of erythropoietically-active and nonerythropoietically-active urine concentrates. The erythropoietic activity of the concentrates and absorbed sera was assayed using the transfusion-induced polycythemic mouse. Qualitative comparisons were made of the antigens in the urinary concentrates and the precipitins produced in the rabbits by the injection of the concentrates. The neutralization of the erythropoietic activity is considered to result from an antigen-antibody reaction, which cannot be assumed to be the precipitation type. (B.O.G.)

9770 (UCRL-9897(p.188-200)) GLUCOSE KINETICS AND OXIDATION AND THE EFFECTS OF INSULIN, TOLBUTAMIDE, AND PHENETHYLBIGUANIDE (DBI) IN NORMAL HUMAN SUBJECTS. M. Pollycove (California. Univ., Berkeley. Lawrence Radiation Lab.).

The rate of glucose oxidation in the normal subjects is in good agreement with reported values. The CO_2 pool size and turnover rate are also in good agreement. Intravenous (I.V.) injections of insulin results in the reduction of the entry of glucose into the exchangeable pool from 13 g/kg/hr

to zero within a minute after injection, and simultaneously increases glucose oxidation. The effect of insulin administered subcutaneously (S.C.) appears similar and consistent with the delayed entry of relatively small amounts of insulin into the blood. The delay in onset of constant glucose specific activity seen after the I.V. administration of tolbutamide is intermediate in duration between the immediate effect of insulin, I.V., and the 25-min delay seen after insulin, S.C. The periods during which the glucose specific activity is constant and the $C^{14}O_2$ specific activity increased are more prolonged than with insulin I.V. The data suggest that tolbutamide may be effective as a result of its capacity to stimulate the endogenous release of insulin. (B.O.G.)

9771 (UCRL-9897(p.201-21)) ISOTOPE TURNOVER STUDIES WITH THE WHOLE-BODY COUNTER. T. Sargent (California. Univ., Berkeley. Lawrence Radiation Lab.).

This paper was given a limited distribution as UCRL-9718 entitled "Metabolic Studies with Fe^{59}, Ca^{47}, and C^{11} in Various Diseases" and was presented at the Symposium Whole-body counting, IAEC, Vienna, Austria, June 12-16, 1961.

Discussions are given of shielding studies made for the whole-body counter, and safety monitoring and medical research studies performed by the counter. The medical research studies are summarized in terms of metabolic studies of iron-59, calcium-47, and carbon-11 in various diseases. (B.O.G.)

9772 REPOPULATION OF THYMUS BY IMMUNOLOGICALLY COMPETENT CELLS DERIVED FROM DONOR MARROW. Raymond A. Popp (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med., 108: 561-4(Dec. 1961).

Many of the sublethally irradiated $B1F_1$ and $B6D2F_1$ mice injected intraperitoneally with thymus cells from parental strain donors died within 90 days, owing presumably to an immunological reaction by the implanted cells against the recipient. Likewise, regenerated thymus tissue of lethally irradiated $B1F_1$ mice injected with C57BL bone marrow cells induced a fatal wasting disease on implantation in sublethally irradiated $B6D2F_1$ mice. It was concluded, therefore, that regenerated thymus tissue in lethally irradiated $B1F_1$ mice injected with C57BL bone marrow was repopulated by immunologically competent cells derived from the donor marrow. (auth)

9773 INFLUENCE OF SEX ON BONE MARROW TRANSPLANTATION IN MICE WITH INDUCED TOLERANCE. Alberto P. Cristofanini, Earl V. Long, and Leandro M. Tocantins (Jefferson Medical Coll., Philadelphia). Proc. Soc. Exptl. Biol. Med., 108: 689-92(Dec. 1961).

Mice of A/Jax and C_3H strains were injected at birth with bone marrow cells from females of the opposite strain in an attempt to induce tolerance. Skin grafting experiments demonstrated that both males and females so treated did acquire a slight degree of tolerance. When the partially tolerant female mice were used as donors or hosts in homologous bone marrow transplantation experiments (with the opposite strain), the date of appearance of the secondary disease was delayed, an effect attributable to acquired tolerance. However, when partially tolerant males were used, survival did not increase, but actually decreased. The animals died in a very short time, as if hypersensitized. It has been proposed that the tolerant animals are chimeras; if so, the male animals may contain female cells already hypersensitized against male, and these hypersensitized cells may be responsible for the short survival. (auth)

9774 CHANGES IN SERUM PROPERDIN OF MICE DURING TUMOR GROWTH AND FOLLOWING IMMUNIZATION TO EHRLICH ASCITES CARCINOMA. M. Richard Troeh, Charles R. Slater, William M. Larson, Jr., and Ralph W. McKee (Univ. of California, Los Angeles). Proc. Soc. Exptl. Biol. Med., 109: 51-4(Jan. 1962).

Employing a modified McNall procedure for determining serum properdin it was shown that in C57/BL mice growing Ehrlich ascites carcinoma there was a progressive drop of serum properdin after 3 days. Similar decreases of serum properdin values in C3H and A/He mice occurred when they were growing Gardner lymphosarcoma and L No. 2 lymphoma, respectively. On the contrary, when C57/BL mice were given either repeated injections of 2000 r x-irradiated Ehrlich carcinoma, or repeated injections of x-irradiated tumor and 3 to 5 challenges of viable tumor, there was a transient drop with a return to a normal blood level of properdin. However, numerous challenges of mice that received repeated injections of x-irradiated tumor resulted in a significant lowering of the serum properdin, but not to levels produced with actively growing tumor. There appeared to be a correlation of serum properdin with cancer growth. During cancer growth there was a fall in serum properdin, while regression was accompanied by a rise back to control levels of serum properdin. (auth)

9775 THE DISTRIBUTION OF RADIOYTTRIUM AND RADIOACTIVE RARE EARTHS IN MAMMALIAN ORGANS. III. METABOLISM STUDIES ON MICE AND GUINEA PIGS WITH RADIOCERIUM ($Ce^{144}-Pr^{144}$). Ernst Spode and Friedrich Gensicke (Institut für Medizin und Biologie der Deutschen Akademie der Wissenschaften, Berlin-Buch). Z. Naturforsch., 16b, 684-91(Oct. 1961). (In German)

The distribution and elimination of $Ce^{144}-Pr^{144}$ after parenteral application was reported for mice and guinea pigs. A variation of the pH values of the injection solution as well as an addition of inactive isotopic materials influence significantly the metabolic behavior of the radioisotopes studied. The high accumulation of the radiocerium in the liver during the first days after the incorporation was emphasized. (tr-auth)

9776 STRAHLENFORSCHUNG UND STRAHLENBEHANDLUNG. VORTRÄGE AUS DEN GEBIETEN DER STRAHLENPHYSIK, STRAHLENBIOLOGIE UND STRAHLENTHERAPIE. BAND II. 41. TAGUNG DER DEUTSCHEN RÖNTGENGESELLSCHAFT IN FREUDENSTADT VOM 11. BIS 14. MAI 1960. (Radiation Research and Radiotherapy. Lectures from the Areas of Radiation Physics, Radiobiology, and Radiotherapy. Volume II. 41st Session of the Deutsche Rontgengesellschaft in Freudenstadt from May 11 to 14, 1960. Hans Meyer and Josef Becker, eds. Sonderbände zur Strahlentherapie. Band 46. Munich, Urban & Schwarzenberg, 1960. 259p.

Thirty-four papers presented at the meeting of the Deutsche Rontgengesellschaft from May 11 to 14, 1960, are compiled. The topics of the papers given cover the following subjects: treatment of malignant melanomas of the skin, sieve irradiation, telecobalt therapy, radiobiology and radioclinology, clinical and experimental radiotherapy, and dosimetry and radiation protection. (J.S.R.)

9777 CLINOLOGY AND THERAPY OF THE ADVANCED STAGES OF MALIGNANT MELANOMA. Hanno Poppe (Chirurgische Universitätsklinik, Göttingen, Ger.). p.1-24 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

Methods used for the diagnosis and treatment of advanced stages of malignant melanoma are reviewed. Emphasis is given to individual cases and combined uses of surgery and radiotherapy. (J.S.R.)

9778 THE TREATMENT OF MALIGNANT MELANOMAS OF THE SKIN WITH INCLUSION OF MELANOTIC PRECANCEROSIS. Guido Meischer. p.25-35 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

A review is given of the treatment of malignant melanomas and the results obtained. Surgical and radiotherapy data singly and combined are tabulated. The treatment of melanotic precanceroses is briefly considered. (J.S.R.)

9779 THE TREATMENT OF MALIGNANT MELANOMA OF THE SKIN. Brian W. Windeyer (Middlesex Hospital, London). p.36-42 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In English)

The British view of the principles which should be adopted in the treatment of malignant melanomas of the skin is reviewed, and the reasons why surgical excision is considered to be the primary method of treatment of this condition are discussed. (auth)

9780 THE TREATMENT AND PROPHYLAXIS OF THE SKIN TUMORS OF MALIGNANT MELANOMAS. Robert Wernsdoefer (Universitäts-Hautklinik, Erlangen, Ger.). p.43-8 of "Strahlenforschung und Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

In addition to the results of radiation treatment of melanomas, there is a whole series of effective prophylactic precautions which improve the prognosis of this tumor. These precautions are briefly reviewed. (J.S.R.)

9781 PHYSICAL FUNDAMENTALS OF SIEVE IRRADIATION. Gerhard Breitling (Universität, Tübingen, Ger.). p.51-9 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

As an introduction to the fundamentals of sieve radiation the two concepts, aperture ratio and homogeneity quotient, are defined. The factors determining the configuration of the radiation field can be summarized in three groups: geometric factors, permeability of the sieve material, and scattering radiation effect. These three factors are discussed and illustrated. (J.S.R.)

9782 THE BIOLOGICAL EFFECT OF SIEVE RADIATION. Detlev Schoen (Universität, Tübingen, Ger.). p.60-7 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The biological effects of sieve irradiation are compared with those resulting from grid irradiation, and the reasons for the differences are reviewed. (J.S.R.)

9783 CLINICAL PRACTICES AND RESULTS OF SIEVE RADIATION. Benjamin Jolles (General Hospital, Northampton, Eng.). p.68-77 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The great advantages of an increased skin tolerance and the lowering of the general effect outweigh decidedly the suspected disadvantages of an inhomogeneity and the danger that one would depend too much on the indirect effects, such as diffusible substances and stroma effects. All parts of a tumor must receive an empirically adequate radiation dose. The biological bases of the increased body and tissue tolerance and the fluctuation of normal and irradiated tissues are shown. The physiological results outside of the visible skin reactions are discussed. The indicators for the application of the sieve method are described. The results of sieve irradiation in 942 cases of lung cancer, 83 bladder cancers, and 75 malignant ovary tumors are compared with the results of other treatment methods. (tr-auth)

9784 CLINICAL PRACTICES AND PROBLEMS OF SIEVE RADIATION. Peter Kroeker (Evangelische Krankenhauses Huyssens-Stiftung, Essen). p.78-84 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

In addition to a proof of the advantages of sieve irradiation, some indications on the clinical practices are given. The spatial distribution alone is no doubt very important; its combination with the temporal fractionation appears, however, of special significance. Radiation therapy using this method gives more possibilities and prospects for tumor control. (tr-auth)

9785 SIEVE RADIATION IN SUPERVOLT THERAPY. Helmut Kuttig (Universität, Heidelberg). p.85-94 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The advantages obtained with sieve irradiation suggested the application of this technique to supervolt therapy, such as fast electrons, hard x rays from a betatron, and Co^{60} gamma radiation. The homogeneity and inhomogeneity of the radiation with each type of beam in a sieve technique are considered. The indicators used are discussed, and the therapeutic results of sieve irradiation with fast electrons, hard x rays, and gamma rays are reviewed. It is concluded that sieve irradiation with supervolt therapy represents a complementary method in the treatment of tumors. (J.S.R.)

9786 ZURICH PRACTICES AND TREATMENT RESULTS FROM GRID IRRADIATION (200 kv) IN COMPARISON WITH TREATMENT WITHOUT GRID (200 kv AND 31 Mev). Umberto Cocchi (Universität, Zurich). p.95-100 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The results obtained from the treatment of 172 patients with malignant tumors using conventional x-ray treatment with the application of a plumboresinite grid are reported. The clinical procedures are described in detail. The skin reactions occurring after grid irradiation are compared with the reactions resulting from conventional techniques. The survival rates are also compared. It is concluded that the treatment results from grid irradiation do not vary essentially from those obtained without a grid. (J.S.R.)

9787 BIOLOGICAL INVESTIGATIONS OF THE SIEVE EFFECT. Werner Dietz and Arnold Poeschel (Universitäts Frauenklinik, Freiburg i. B.). p.101-7 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie.

Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

Leukocyte resistance against pressure oscillations was used as the biological parameter in comparative studies in rats exposed to full-field or sieve irradiation. A homogeneous plastic plate, or plumboresinite, was used for the sieve irradiations. The special sieve combination appeared to have advantages as a radiation protection material. (C.H.)

9788 COMPLICATIONS WITH RESPECT TO THE HEART AND THE CIRCULATION IN IRRADIATIONS OF THE THORAX. Helmut Hartweg (Universität, Tübingen, Ger.). p.108-15 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

On the basis of a literature search and some experimental and clinical results, the radiation burden of the heart and the results of this radiation burden are reported. In the therapeutically significant dose range, morphological damages are scarcely observable; on the other hand functional disturbances play a role. These are manifested in blood pressure drop, tachycardia, and EKG changes. In healthy hearts they are generally of a transient nature. Pathologically altered hearts deteriorate in 50% of the cases under a high-dose irradiation. Here a rigorous monitoring, possibly in cooperation with an internist, is necessary in order to avoid lethal complication of the heart–circulatory system. (tr-auth)

9789 SIEVE IRRADIATION OF BLADDER CARCINOMAS. Walter Pfeifer and Herbert Wuerdinger (Oldenburgische Landeskrankenhauses, Sanderbusch, Ger.). p.116-23 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The treatment of 28 bladder carcinomas at Oldenburgische Landeskrankenhaus since 1956 is reported. Twenty of these were checked histologically. Three were in the incurable state at admission; the remaining 25 underwent a combined surgical-radiological treatment, which consisted preponderantly in the histological clarification, electro-resection of the tumor nodes larger than beans, and concurrent x-ray fine sieve irradiation. Of the 25 completely treated bladder carcinomas 19, or 76%, still survive. In none of them did the latest control studies show a local relapse. (tr-auth)

9790 RESULTS WITH SIEVE RADIATION IN RECTAL CARCINOMA. Eberhard Scherer (Universität, Marburg/Lahn, Ger.). p.124-7 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The guiding principles in the irradiation of rectal carcinomas were briefly illustrated by means of 120 cases. In rigorously localized processes, all dilating tumors should be treated with sieve irradiation, in case ultrahard radiation is not available. The combination with endorectal Co^{60} treatment was recommended as preoperative therapy in the cases which occasionally can be made operable by radiation treatment. (tr-auth)

9791 RESULTS WITH SIEVE IRRADIATION OF GYNECOLOGICAL CARCINOMAS. Rolf Frischkorn (Universitäts-Frauenklinik, Göttingen, Ger.). p.128-33 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

Gynecological radiation therapy is today capable of healing completely up to 50% of the carcinoma patients. The various methods are practically equivalent with each other with respect to their efficiency. The obtention of an adequate deep dose in a large focal range, however, often makes great difficulties, especially at considerable depths. Here the sieve radiation is doubtless in numerous cases capable of expanding the irradiation possibilities so that a treatment could be completely carried out. On these bases, sieve radiation was used at the Universitäts-Frauenklinik, Göttingen, as a valuable supplement of radiation therapeutic tools for 2½ yrs. The methods and preliminary results are reported. (tr-auth)

9792 SITE CONTROL OF SIEVE FIELDS BY PHOTOGRAPHS WITH THE THERAPY TUBE. Helmut Buttenberg (Röntgen-Radium-Institut der Medizinischen Akademie, Erfurt, Ger.). p.134-42 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The irradiation of malignant tumors in the body cavity represents a local irradiation method. The greatest accuracy is necessary in the placement of sieve fields. Site controls, which could serve this purpose, must fulfill given conditions with respect to simplicity, reproducibility, approach to the radiation desired, and radiation protection. The utility of sieve field photographs with the therapy tube was investigated, confirmed on the basis of suitable methods, and illustrated with examples. (tr-auth)

9793 THE SPECIAL BIOLOGICAL MODE OF ACTION OF SIEVE IRRADIATION. Hans-Juergen Eichhorn (Institut für Medizin und Biologie der Deutschen Akademie der Wissenschaften, Berlin and Arbeitsbereich Klinik). p.143-4 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

Studies on the radiobiological peculiarities of sieve irradiation have shown that only at the surface are there found the physical assumptions for special biological reactions from sieve radiation. It is concluded that all increased effects found at the site of the radiation are the result of higher doses. Limited radiation syndrome and high skin tolerance as phenomena of sieve irradiation are a consequence of the special dose distribution at the surface. (J.S.R.)

9794 TELECOBALT THERAPY OF BLADDER TUMORS. IMPRESSIONS AFTER TWO YEARS. Gerhard Hinz (Städt. Krankenhaus Moabit, Berlin). p.147-50 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The preliminary results in the treatment of bladder tumors with telecobalt therapy are reported. They show that this technique offers advantages in the treatment of bladder tumors, especially with respect to the higher local dose obtained, the greater skin preservation, and the much better tolerance. A simplification of the dosimetry in pendulum irradiation was available since the dose value measured in the water phantom with respect to the absorption uniformity of the various tissues for Co^{60} was transferable to the human body. The necessity for a close cooperation between urologists and radiologists for the treatment of bladder tumors is shown, and preoperative irradiation is discussed. (tr-auth)

9795 CLINICAL REACTIONS IN TELECOBALT THERAPY. Karlheinz Renner. p.151-61 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den

Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

About 30 to 40% of all patients treated with radiation therapy are treated with telecobalt therapy. This distribution is confirmed by literature references and emphasizes the significance of this form of therapy. The skin reactions are lower (synthesis effect). The erythema dose is, after single irradiations, about 1700 r, after total doses of 3000 to 4500 r fractionated in 200 r, according to the body region (field size 150 to 200 cm^2 without tube in stripped skin). The erythema pattern is moderated; at doses of 6000 to 8000 r it decays during treatment. The epilation dose corresponds to 200 kv irradiation. Subcutaneous indurations were not observed at doses up to 5000 r. Mucous membrane reactions are stronger with respect to 200 kv therapy. Endolaryngeal fibrin coatings were observed in 80 to 100 cm^2 fields (200 kv after 3500 r) at doses between 1900 and 4000 r, in the mean at 3000 r (200 r daily). In fields of 20 cm^2 no reaction is visible up to 6000 r. In the literature bone necroses of the mandibula in connection with tooth extractions are described. About 6500 rad was given as the safety limit. The general reaction is diminished in cobalt radiation. The radiation leukopenia is lower, even when tumor and volume doses are increased. The result of the statistical evaluation of clinical reactions is compared with radiation chemical investigations and make probable the radiation specific and objective dependent effective differences between Co^{60} and 200-kv therapy. (tr-auth)

9796 PROTECTION OF THE HUMAN GONADS IN TELECOBALT THERAPY. Walter Ahlendorf (Universität, Jena, Ger.). p.162-4 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

A description is given of an apparatus designed for the protection of the scrotum during telecobalt therapy. The radiation burden received by the gonads during radiotherapy with and without the protective capsule was measured. The results showed that the capsule reduced the gonad dose by a factor of 10. (J.S.R.)

9797 ACTIVITY AND PENUMBRA PROBLEMS IN COBALT TELETHERAPY INSTRUMENTS. Erich Walter (Siemens-Reiniger-Werken A. G., Erlangen, Ger.). p.165-71 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

It is shown that exceeding a minimum value of the activity impairs the economic ratios of a cobalt irradiator. For the establishment of the minimum limits considerations on patient frequency are given. It is also shown that the penumbra both with respect to the width of the penumbra zone and also with respect to the dose pattern does not depend very strongly on the source diameter. (tr-auth)

9798 LATEST RESULTS OF RADIOBIOLOGY IN ITS RELATIONSHIP TO THE CLINIC. Ruprecht Koch (Universität, Freiburg i. B.). p.175-9 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The interrelationship of experimental radiobiology and clinical practices of radiologists is illustrated by means of several examples. (J.S.R.)

9799 RADIOCLINICS AND RADIOBIOLOGY. Kurt Ernst Scheer (Universität, Heidelberg, Ger.). p.180-5 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

For the improvement of treatments of malignancies in man, there are two basic approaches. One is the investigation of the primary phenomena of life, and the other is the expansion of radiological techniques. The interrelationship of these two problems is discussed. (J.S.R.)

9800 RESULTS WITH THE TREATMENT OF PENIS CARCINOMAS BY RADIUM PUNCTURE. Eberhard Baudisch (Universität, Jena, Ger.). p.195-201 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The treatment of penis carcinomas with the method of radium puncture is reported. In 15 years (1939 to 1954) 58 patients were treated with this method. The indications for the radiological treatment of the penis carcinomas are given, and the technique of radium puncture is described. Of the 58 patients, 32 patients, or 55%, were still living five years after the puncture. Thirty of the 32 patients were free from relapse for this period. Twenty of the 26 deceased died within the first three years, 16 because of their basic disease within, on an average, 16 months after the radium treatment. By limiting this method to less expanded penis carcinomas, the results could be improved. (tr-auth)

9801 THE DOSE CONCEPT. Richard Glocker (Technische Hochschule, Stuttgart). p.202-7 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The concept of radiation dose is discussed first on the basis of physical units. The definition of a physical concept has the advantage that it is independent of the selection of the measurement units. The dependence of the dose on the measurement volume is described and illustrated. In the application of the dose concept in radiology one must know the mathematical relationships which connect the dose measured in one material to the dose in another material. The definition of rad is given and discussed. (J.S.R.)

9802 MEASUREMENT OF INCORPORATED RADIUM AND THORIUM WITH THE WHOLE BODY COUNTER (HUMAN COUNTER). Erich Oberhausen, Hermann Muth, and Charles O. Onstead (Universität, Saar, Homburg, Ger. and Army Medical Research Unit No. 1, Landstuhl Army Medical Center, Ger.). p.208-12 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

Measurements on employees of the radium processing industry and on patients receiving thorotrast were made with a human counter developed and built in the USA (Los Alamos). The calibration of the instrument was done through use of a suitable phantom with radium standard or thorotrast solutions. The first measurement results are reported and discussed. (tr-auth)

9803 ISOTOPIC NEPHROGRAPHY IN ABDOMINAL TUMORS. Karl zum Winkel (Universität, Heidelberg). p.213-19 of "Strahlenforschung und Strahlenbehandlung.

Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The changes in isotopic nephrograms of 124 patients with abdominal tumors are reported. Only in 36% were the findings normal. A scheme for the classification of discharge perturbations in the isotopic nephrogram was formulated for improved diagnosis and prognosis. The results of the separation urography and the isotopic nephrography in 95 of the investigated illnesses were compared with each other. (tr-auth)

9804 EFFECTS OF IONIZING RADIATION ON MOUSE EMBRYOS. Johannes Trautmann (Städt. Krankenhaus Moabit, Berlin). p.220-2 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

Publications, one by Schubert and the other by Beck, on early damage in men are briefly reviewed, with the result that the questions of what radiation dose leads to significant damage in the embryo and what dose to the embryo leads to damage in the young after birth are asked. The radiation effects on mouse embryos in the preimplantation period, from the time of impregnation up to the formation of the principal organs, are reviewed. After whole body irradiation of pregnant mice with 200 r, heavy damages to the fetal remnants are observed. No damage can be detected after 100 r. Some authors say that damage traceable to radiation occurs after 50 r, often after 25 r. (tr-auth)

9805 THE RADIATION BIOLOGY OF THE WHITE MOUSE. 1200 R WHOLE-BODY IRRADIATED AT HIGH DOSE OUTPUTS. Kurt Heuss (Max-Planck-Institut für Biophysik, Frankfurt am Main). p.223-7 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

Mice of both sexes were exposed to a whole body irradiation of 1200 r in a dose output range from 1 to 150,000 r/min. The mean survival time decreases from about 9 days at 1 r/min to 3.5 days at 100 r/min. At higher dose outputs further decreases were indicated, which, however, could not be proved statistically. At 150 r/min and at very low dose outputs there was a significant variation between the sexes. (tr-auth)

9806 THE HISTAMINE HYPOTHESIS OF THE BIOLOGICAL EFFECTS OF X RADIATION. Kurt Flemming (Universität, Greifswald, Ger.). p.228-33 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

With respect to the histamine hypothesis of biological radiation effects, the research results reported prove the accuracy of the assumption that the pharmacologically effective material formed in x-irradiated histidine solutions is identical with histamine. There is, however, no reference that this histamine formation, as the histamine hypothesis assumes, has no noteworthy significance for the biological effects of x radiation. (tr-auth)

9807 CONCENTRATION OF THE ELECTROLYTES AND THE ENERGY-RICH PHOSPHATES IN HUMAN ERYTHROCYTES AFTER IRRADIATION. Heinz Breuer and Heinz Karl Parchwitz (Chirurgische Universitätsklinik und Poliklinik, Bonn). p.234-8 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

Human erythrocytes were incubated for 2 hr at 37°C in glucose-containing Krebs-Ringer phosphate solution. The behavior of the potassium, sodium, adenosine triphosphate (ATP), adenosine diphosphate (ADP), and 2,3-diphosphoglycerinic acid (2,3-DPGS) was investigated in nonirradiated and irradiated erythrocytes. After irradiation with a dose of 10,000 r and 100,000 r, the concentration of ATP and 2,3-DPGS decreased, whereas the concentration of ADP increased. The potassium concentration of the irradiated erythrocytes was also decreased; the sodium concentration, however, increased. It was assumed that the irradiation inhibits glycolysis and therefore the formation of ATP and 2,3-DPGS; as a result of the decreased ATP concentration, a reduction of the concentration gradients for potassium and sodium between the erythrocytes and the extracellular space occurs. (tr-auth)

9808 CLINICAL AND EXPERIMENTAL INVESTIGATIONS ON THE EFFECT AND BEHAVIOR OF ESSENTIAL FATTY ACIDS IN THE RADIATION SYNDROME. Anton Gregl (Chirurgische Universitätsklinik, Göttingen, Ger.). p.239-46 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

A review is given of clinical and experimental studies on the effect and behavior of essential fatty acids in the radiation syndrome. (J.S.R.)

9809 THE EFFECT OF RADIATION PROTECTIVE MATERIALS ON THE ERYTHROCYTE SURVIVAL TIME IN WHOLE-BODY IRRADIATION. Hans Werner Pabst and Christian Strohm (Universität, Munich). p.247-50 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The erythrocyte survival time was determined in rabbits with the help of Cr^{51}. Whole-body irradiation with 220 r gave in the research animals a decrease of the erythrocyte survival time with respect to the control animals, whereas a preliminary treatment with yeast extracts, glutathione, and cobalt salts leads to a significant decrease. Cysteamine, however, at various doses gave no protective effect. The effect of the investigated substances was sought in a direct or indirect modification of the enzyme complexes of the erythrocytes. (tr-auth)

9810 ELECTRON MICROSCOPIC FINDINGS IN EXPERIMENTAL DAMAGE TO THE CENTRAL NERVOUS SYSTEM OF MAMMALS BY X RADIATION. Hermann Hager, Alfred Breit, and Wolfgang Hirschberger (Hirnpatholgische Institut der Deutschen Forschungsanstalt für Psychiatrie, Munich). p.251-2 of "Strahlenforschung und Strahlenbehandlung. Vorträge aus den Gebieten der Strahlenphysik, Strahlenbiologie und Strahlentherapie. Band II." Munich, Urban & Schwarzenberg, 1960. (In German)

The fine structure of the central nervous tissue of gold hamsters after exposure to relatively high radiation doses was investigated using an electron microscope and the ultra-thin section technique. Necrosis areas dissimilated by bleeding was observable after all doses used. At higher doses the sharp and regular limiting of the necrosis with respect to the intact brain tissue is especially remarkable. An agreement of form and expansion of the necrosis field with the path of the dose decay was detected. Completely heterogeneous brain localities were embedded in the

damaged zone. Bleeding and exudations were detected in the vicinity of the sharply limited damaged zone. Astrocyte swellings were found in the vicinity of the necroses. Cell processes uniting with each other show beginning dissociation. In dying tissue, fine structure studies showed the damage of the basic cytoplasm. These results are briefly discussed. (J.S.R.)

Biochemistry, Nutrition, and Toxicology

Refer also to abstracts 11059, 11060, and 11061

9811 (TID-14972) A. TECHNICAL PROGRESS REPORT [ON METABOLISM IN NERVOUS SYSTEM]. (Northwestern Univ., Evanston, Ill.). [1961]. Contract [AT(11-1)-89]. 7p.

Progress is reported in investigations into nucleic acid and protein metabolism in the central nervous system. Data are presented from biochemical and histochemical studies of metabolism in the nervous system of cats. (C.H.)

9812 (UCLA-501) PLUTONIUM, ITS BIOLOGY AND ENVIRONMENTAL PERSISTENCE. J. H. Olafson and K. H. Larson (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Dec. 1961. Contract AT(04-1)-Gen-12. 26p.

A review of the literature pertaining to plutonium and the manifold manifestations of its toxicity is presented. Plutonium as an environmental contaminant would not, on the basis of the evidence presently available, appear to be a serious problem. Since it decays by emission of alpha particles it presents no hazard in terms of external whole-body radiation. It is absorbed by plants growing on contaminated soil to an infinitesimal degree, although it may be found as an external contaminant on vegetation. Ingested Pu is absorbed and retained in animal tissues to a very small degree. Therefore, relatively high levels in dietary constituents can be tolerated without producing a ponderable tissue burden. Extremely high levels of Pu^{239} are required to produce even superficial tissue damage in the digestive tract. Inhalation of airborne particulates remain as the most effective means of entry into higher animals including man. But for this mechanism to produce a tissue burden, there must be significant airborne concentrations. The available information indicates that even in localized regions having very high levels of deposited Pu^{239} that the levels in air are, except for occasional periods, low in comparison to what is considered as tolerable concentrations for occupational exposure. Animal tissue assays have verified that very little Pu gains entry into mammalian systems from the contaminated environment. While no one should be alarmed about concentrations of Pu^{239} in the environment of man, or more specifically in human beings themselves, we would urge caution in drawing conclusions regarding ecological implications. (auth)

9813 (AEC-tr-4996) TOXICOLOGICAL CHARACTERISTICS OF SOME EPOXY RESINS. N. I. Shumskaya. Translated from Gigiena Truda i Professional'. Zabolevaniya, No. 12, 34-9(1961). 6p.

An investigation was made of the toxic effects of ED-5 and E-40 epoxy resins on rabbits, guinea pigs, rats, and mice. The resins were not very toxic when introduced into the stomach or subcutaneously. The minimum lethal dose of ED-5 for mice is 5 g/kg. When the resins are heated to 60 to 100°C, volatile substances are given off, which were found to contain epichlorohydrin and toluene. Prolonged inhalation, by rats, of the vapors given off at 80 to 90°C resulted in chronic intoxications. A concentration at which the epichlorohydrin content of the air does not exceed 0.001 mg/liter is recommended as an approximate limiting allowable concentration of the vapors given off by ED-5 and E-40. Repeated application of the ED-5 resin to some rabbits and guinea pigs caused irritation of the skin with signs of an allergic nature. (B.O.G.)

9814 NECROSIS IN TREATMENT OF INTRAORAL CANCER BY RADIATION THERAPY. William S. MacComb (Univ. of Texas, Houston). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 431-40(Mar. 1962).

Discussion is given on the treatment of necrosis developing from radiotherapy of intraoral cancer. The best treatment of radiation necrosis is prophylactic. The time of appearance of radiation necrosis is also discussed. The incidence of radiation necrosis in treatment of patients with cancer of the intraoral cavity at M. D. Anderson Hospital during the past nine years is tabulated along with the extent and results. Close follow-up of all patients treated for cancer of the intraoral cavity by radiation, and the dangers of attempting to re-irradiate a lesion previously treated by radiation of any kind are emphasized. (P.C.H.)

9815 ISODOSE CURVES AND RADIATION DISTRIBUTION ABOUT PATIENTS WITH INTRACAVITARY RADIUM SOURCES. Hans-Guenter Wandel (Swedish Hospital, Seattle). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 500-3(Mar. 1962).

The radiation distribution around 10 patients with intracavitary radium sources of different intensities was determined by means of a calibrated Beckman Iometer. The averages of the readings in standard positions corrected to a 10 mg radium source provide an index for the calculation of the radiation distribution. Radiation protection problems are discussed in the light of the results and the new standards recommended by the AEC. (auth)

9816 PRELIMINARY REPORTS OF CHROMOSOME STUDIES DURING RADIATION THERAPY. Robert C. Goodlin (Univ. of Minnesota, Minneapolis). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 555-8(Mar. 1962).

Studies were made on the possible correlation of chromosome changes occurring in the peripheral leukocytes with the development of leukopenia in patients receiving radiation therapy for carcinoma of the cervix. The results show that a relation does appear to exist. It is felt that the damaged leukocytes may be, in part, an explanation of the leukopenia associated with radiotherapy. (P.C.H.)

9817 DOSE IN DIAGNOSTIC RADIOLOGY: THE EFFECT OF CHANGES IN KILOVOLTAGE AND FILTRATION. G. M. Ardran and H. E. Crooks (Atomic Energy Research Establishment, Harwell, Berks, Eng. and Oxford Univ.). Brit. J. Radiol., 35: 172-81(Mar. 1962).

It is shown that in practice, with many intensifying screens and screen type films, gonad dose need not increase when total filtrations of up to 3 mm of Al or when kvps up to 130 are used. Above this kvp, up to 180, slight increases may occur but are not such as to exceed those at 120 kvp: these slight increases need not deter the use of high kilovoltage techniques for other reasons. Explanations are given for the conflicting statements found in the literature. The importance of good beam limitation and the reduction of radiation leaks and off-focus radiation is stressed. The effects of scatter from filters and the component parts of light beam diaphragms are discussed. (auth)

9818 EFFECTS OF AMINOETHYLISOTHIOURONIUM BROMIDE AND 5-HYDROXTRYPTAMINE ON THE RESPONSE OF C3H MAMMARY TUMOUR ISOGRAPHS TO IRRADIATION IN VIVO. Annabelle Cohen and Lionel Cohen (Johannesburg Hospital, S. Africa). Brit. J. Radiol., 35: 200-4(Mar. 1962).

Aminoethylisothiouronium bromide (AET) and 5-hydroxtryptamine (HT) were both found to inhibit the response of the isogenic mammary carcinoma to doses of radiation which are normally curative in unmedicated controls, reducing the cure-rate to about half its control level. Whole-body irradiation (3 × 100 rads to the whole mouse in addition to local treatment of the tumor) also reduced the cure-rate to approximately the same degree. Combination of the two procedures, however, produced no additive effects; with application of the drugs a trend toward an increasing cure-rate, slightly higher than that obtained in totally irradiated mice without medication, became evident. Direct trans-thoracic irradiation of both tumor and host tissues with the standard test dose of 7500 rads was uniformly lethal to unprotected controls. It was noted, however, that 5-HT appeared to protect mice from the early mortality associated with the visceral phase of the post-irradiation syndrome, thus prolonging survival time, while AET reduced the over-all mortality, presumably by protecting the hematopoietic system. It is concluded that, while AET is probably too toxic for clinical use, a trial of 5-HT may be justified in certain deep-seated cancers where adequate radiation dosage is precluded by the limited tolerance of adjacent viscera. (auth)

9819 DETERMINATION OF LOW QUANTITIES OF RADIOSTRONTIUM IN HUMAN BONE. Pierre Lerch, Marco Quijano, and Georges Banna (Université and Hôpital Cantonal Universitaire, Lausanne, [Switzerland]). Chimia (Switz.), 15: 524-8(Nov. 15, 1961). (In French)

The measurement in human bones of contamination by strontium-90 from stratospheric radioactive fall-out requires highly sensitive apparatus. A Geiger-Müller gas-flow counter having a high efficiency with a very low background is described. It is designed to have a great stability for measurements covering periods of one to many days. The characteristics of the counters are given, as well as a summary of the data of the contamination found in bones in Switzerland in 1960. (auth)

9820 THE EFFECT OF PHARMACOLOGICAL DOSES OF NON-RADIOACTIVE IODIDE ON THE COURSE OF RADIOIODINE UPTAKE BY THE THYROID. E. E. Pochin and C. F. Barnaby (University Coll. Hospital Medical School, London). Health Phys., 7: 125-6(Feb. 1962).

Doses of potassium iodide, containing 200 mg of iodide, inhibited further thyroid uptake of radioiodine in six subjects when given 2.5 or 4 hr after single oral doses of radioiodine. (auth)

9821 ADMINISTRATION OF STABLE IODIDE AS A MEANS OF REDUCING THYROID IRRADIATION RESULTING FROM INHALATION OF RADIOACTIVE IODINE. C. A. Adams and J. A. Bonnell (Central Electricity Generating Board, London). Health Phys., 7: 127-49(Feb. 1962).

Despite the emphasis placed on safety considerations during the design and operation of nuclear power stations, it is prudent to consider the possibility of a reactor accident capable of causing radiological injury to the general public residing in the vicinity. This implies the emission of radioactive material from the reactor. The first danger which must be reduced in connection with certain types of reactor is that resulting from inhalation of radioactive materials by persons in the path of the cloud. All existing evidence suggests that for the type of reactor under consideration, the inhalation of radioactive iodine is the most immediate hazard. Iodine is selectively absorbed and concentrated in the thyroid gland where it is retained for relatively long periods. In this report an analysis is given of the factors governing the uptake of iodine by the thyroid glands, and, by using data available in the literature, it is shown to be probable that the ingestion of small amounts of inorganic iodide would significantly reduce the dose due to concurrently inhaled radioactive iodine. It is therefore advocated that the administration of stable iodide should be seriously considered as an alternative or supplement to evacuation of any persons at risk from inhalation, following a reactor accident. The adoption of this suggestion would simplify emergency plans by reducing the need for evacuation or at least add valuable time during which evacuation could be better organized. (auth)

9822 BODY-BURDEN PROBLEM. John Z. Hearon (National Institutes of Health, Bethesda, Md.). Health Phys., 7: 157-9(Feb. 1962).

If amount q of a radioactive isotope is injected in a single dose, the body burden is $R_1 = qF(t)$ where $F(t)$ is some non-negative monotone decreasing function. Similarly $R_2 = \int_0^t G(\theta)F(t-\theta)\,d\theta$ is the body burden under continuous injection rate $G(t)$. The radiation dosages D_1 and D_2 are the time integrals of R_1 and R_2. It is shown that $D_1/D_2 > (q/\int_0^t G(\theta)d\theta) > R_1/R_2$ for any $F(t)$ with the above-stated properties and any non-negative integrable $G(t)$. The implications of these inequalities are discussed. (auth)

9823 A COMPARISON OF HTO IN PLASMA AND EXPIRED WATER VAPOR. Richard Moore (American National Red Cross, Washington, D. C.). Health Phys., 7: 161-9(Feb. 1962).

Tritium-labeled water was injected intravenously into a young male adult man and the time courses of specific radioactivity in plasma, red cells, urine, and expired water vapor were determined and compared. Specific activity of breath water and urine appeared to follow a pattern of damped oscillation about the curve for the specific activity of plasma water. The transfer function of the biological system for the injection of radioactivity was determined. Results indicated that breath water samples may under certain circumstances be substituted for urine or plasma water samples in the determination of total-body water. (auth)

9824 BIOACCUMULATION OF RADIOACTIVE ISOTOPES BY HERBIVOROUS SMALL MAMMALS. Stephen V. Kaye and Paul B. Dunaway (Oak Ridge National Lab., Tenn.). Health Phys., 7: 205-17(Feb. 1962).

This paper reports body burdens of radionuclides and dose-rate estimations for wild mammals from areas contaminated by radioactive waste disposal. Body burdens determined by radioassay are compared with body burdens estimated by an equilibrium equation. The data were gathered in a pilot-scale field study and will be used to design a more comprehensive study of large numbers of wild mammals. The more abundant radionuclides included Sr^{90}, Ru^{106}, Cs^{137}, and Co^{60}. Almost all of the mammals radioassayed had body burdens that were greater than body burdens expected from world-wide weapons fall-out. The estimated whole-body dose rate from internal sources to one muskrat trapped in a settling basin for radioactive liquid waste was 112 rads/week. The estimated whole-body dose rate from internal and external sources to cotton rats trapped on the White Oak Lake bed was 2.9 rads/week. In-

formation from a population ecology study was used with the bioaccumulation data to estimate the quantity of radionuclides held by a cotton-rat population. (auth)

9825 COMPARISON OF PREDICTED AND MEASURED EQUILIBRIUM LEVELS FOR CHRONICALLY ADMINISTERED Cs^{137}. C. R. Richmond, J. E. Furchner, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.). Health Phys., 7: 219-25(Feb. 1962).

The biological retention of a single oral dose of Cs^{137} was obtained by whole-body counting twelve 89-day-old female RF mice for 32 days. An IBM 704 computer curve-fitting procedure was then used to reduce the retention data into three exponential components, and the resultant retention function was integrated from t_0 to t_n to predict the Cs^{137} retention by mice of the same age at any time t_n during a chronic exposure. Both the predicted build-up of body Cs^{137} activity and the equilibrium level agreed reasonably well with measured values obtained by whole-body counting 89-day-old animals whose drinking water contained 0.012 μc Cs^{137}/ml for a 107-day period. The urinary-to-fecal excretion ratio during the period of observed equilibrium was about 9. These findings provide additional experimental verification for the current practice of using retention parameters obtained from acute experiments to predict equilibrium levels which would be attained during chronic exposure conditions. Retention of Cs^{137} after the termination of chronic exposure did not agree with the retention pattern predicted from the original single-dose experiment, but did agree with the retention pattern predicted from a second single-dose experiment in which animals of the same age as those at the termination of the chronic ingestion period were used. The rather obscure relation between age and retention, and consequently between age and equilibrium level or radiation dose, is discussed. (auth)

9826 THE ABSORPTION AND TRANSPORT OF RADIO-ACTIVE CALCIUM, Ca^{45}, IN TOMATOES, A FIRST REPORT. Chin-Ching Chen and Yu-Yuen Yeh (National Taiwan Univ., Taiwan, [China]). Ho Tsu K'o Hsueh, 3: No. 2, 19-26(1961). (In Chinese)

The absorption and transport of calcium in tomatoes is studied hydroponically by using a Hoagland nutrient solution at half strength. Ca^{45} is used as the tracer. On account of the high temperature of the laboratory, transpirational loss of water is heavy, and the solution has to be checked every day and made up to strength. The "above ground" parts, particularly the leaves, are bathed with the same nutrient solution to see if absorption also takes place and, if absorbed, the direction of transport. The results indicate ready absorption of calcium by all parts of the plant but transport is essentially unidirectional. (TTT)

9827 EXPERIMENTAL STUDIES OF THE EFFECT OF DUST (DUST MIXTURES) OF RARE METAL ORE CONCENTRATES. O. J. Mogilewskaja. J. Hyg., Epidemiol., Microbiol., Immunol. (Prague), 5: 103-12(1961).

A study was made to determine if the mixed dust of a metal-containing compound differs from the dust of the pure metal when administered intratracheally to rats. In the first tests, animals received 50 mg of concentrated beryllium compound (basic component, Be_3Al_2/Si_6O_{18}); in the second tests, a molybdenum compound (basic component, MoS_2); and in the third tests, titanium (main component, TiO_2). Five to seven months after administration, the animals were killed and histologically examined. Within five months the molybdenum compound produced a diffuse proliferative process which by seven months led to a mild diffuse fibrosis. The titanium compound produced a less marked interstitial process. Comparison with pure metal dusts show that the dust of the compounds has a different effect from the pure metal, both as regards the degree and character of the effect. This may be because the effect of the main compound is intensified by the other components. (N.W.R.)

9828 EFFECT OF THE CHELATING AGENT BIS 2-AMINOETHYL ETHER TETRAACETIC (BAETA) ON RADIOSTRONTIUM EXCRETION IN MAN. Herta Spencer, Arthur Feldstein, and Joseph Samachson (Montefiore Hospital, New York). J. Lab. Clin. Med., 59: 445-55 (Mar. 1962).

The effectiveness of the calcium salt of BAETA in enhancing radiostrontium excretion was studied in 6 patients at the time of the injection of the tracer and in 2 of these, 2 weeks thereafter (early and late phase). Infusions of Ca-BAETA led to a considerable increase of urinary Sr^{85} excretion in the early phase in 5 of 6 patients who had normal or low urinary calcium excretion. The chelate was ineffective in the sixth patient who has hypercalciuria due to the osteolytic bone disease. The comparative effectiveness of Ca-BAETA and of calcium gluconate was studied in 3 of these patients. Intravenous calcium gluconate, as well as Ca-BAETA, was ineffective in the hypercalciuric patient, while both agents were equally effective in a patient with normal calcium metabolism. In the third patient, who had a tendency to retain calcium due to osteoblastic bone disease, Ca-BAETA increased the urinary Sr^{85} excretion fivefold, while infusions of calcium gluconate did not lead to an increase of the calciuria or to enhancement of radiostrontium excretion. In 2 patients in the late phase, Ca-BAETA led to a prompt increase of urinary Sr^{85} excretion. (auth)

9829 RADIOACTIVE INERT-INDICATOR METHOD FOR INTESTINAL ABSORPTION UTILIZING DIFFERENTIAL COUNTING. Burton Seife (Yale Univ., New Haven). J. Lab. Clin. Med., 59: 513-19(Mar. 1962).

The measurement of the fraction of a test substance absorbed from the gut was facilitated by mixing a nonabsorbable inert indicator with the test meals. Only the ratio of test substance to inert indicator in the test meal and stool need be known. $Ba^{131}SO_4$ was used as an inert indicator. A 2 channel gamma ray spectrometer system differentiates the emanations from Ba^{131}, the inert marker, from the emanations of the I^{131}-labeled nutrient. Tests in mice revealed that there is no significant exchange of $Ba^{131}SO_4$ across the bowel. Dogs in whom a triolein I^{131}-Ba test was run were also studied with a 72 hour metabolic fat balance study. Results are parallel. The advantages of this method are: the fraction of test substance absorbed from the gut is the parameter measured and no consideration need be given to blood volume, gastric emptying time, or size of test meal; random stool samples can substitute for total quantitative collection and quantitative consumption of the test meals is not necessary; the assay of radioactivity is performed on wet unweighed samples of comparable geometry which is much simpler than chemical or spectrophotometric analyses on dried weighed specimens. (auth)

9830 RAPID METHOD FOR DETERMINATION OF DECARBOXYLATION OF COMPOUNDS LABELLED WITH CARBON-14. J. Chiriboga and D. N. Roy (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Nature, 193: 684-5(Feb. 17, 1962).

A rapid and accurate method of determining the rate of decarboxylation activity of different types of tissues is described along with the vessel used for the method. The

method is based on the evolution of $C^{14}O_2$ from substrate on filter paper impregnated with potassium hydroxide. Results are given which show the reproducibility of the method of decarboxylation of ascorbic acid 1-C^{14} by rat tissue homogenates and the efficiency of the method of decarboxylation of ascorbic acid by different amounts of rat liver homogenate. The quenching effect of potassium hydroxide paper in a toluene scintillator is also shown. (N.W.R.)

9831 TIME-DISTRIBUTION EXAMINATION OF THE IN VIVO INCORPORATION OF SELENIUM INTO CYTOCHROME C OF THE RAT AND ITS TURNOVER. Kenneth P. McConnell and R. Duncan Dallam (Univ. of Louisville, Ky.). Nature, 193: 746-8(Feb. 24, 1962).

Experiments are reported which demonstrate that Se^{75} administered as H_2SeO_3 is incorporated into whole-rat carcass cytochrome c. The concentration of Se^{75} in the cytochrome c increased rapidly to a maximum in 6 hr and thereafter declined slowly over a 3-week period. A provisional half life of 14 hr for cytochrome c in the young female rat is proposed. Neutron activation analyses of purified commercial horse heart cytochrome c showed that it contained trace amounts of stable selenium on the order of a few tenths of $\mu g/g$. (D.L.C.)

9832 MICROSPHERES FOR RADIATION THERAPY. John F. Perry (Univ. of Minnesota, Minneapolis), Merle K. Loken, John P. Ryan, and Lloyd D. MacLean. Nucleonics, 20: No. 3, 70(Mar. 1962).

The treatment of malignant tumors with ionizing radiation using ceramic microspheres that can be localized at selected sites for interstitial therapy is discussed. Thus, radiation damage in healthy tissues can be minimized by tailoring radioactivity to control dose, dose rate, and volume of tissue irradiated. The mean life, radiation energies, and beta-gamma dose can be adjusted by blending mixtures of radioisotopes in the spheres. Equations for calculating the activity needed are given. Manufactured in sizes of 10 to 200 microns, the spheres have an absolute density of 3.0 g/cm^3. They can be tagged with cationic activities up to about 10^4 curies/g of microspheres. The characteristics of several radioisotopes that may be used in the spheres are given. (N.W.R.)

9833 STOP FLOW ANALYSIS OF RENAL TUBULAR SITE OF REABSORPTION OF RADIOIODIDE IN DOGS. Harold E. Williamson, J. R. Scranton, F. N. Marshall and N. S. Halmi (Univ. of Iowa, Iowa City). Proc. Soc. Exptl. Biol. Med., 109: 23-6(Jan. 1962).

The renal tubular site of reabsorption of iodide has been determined in the dog using the stop flow technique. The pattern for I^{131} was found to be qualitatively similar to that for chloride or sodium. However, I^{131} was reabsorbed to a lesser extent than chloride or sodium in both distal and proximal segments. Administration of large doses of stable iodide, perchlorate or thiosulfate did not greatly affect the stop flow ratios of I^{131}. These experiments are interpreted as indicating passive reabsorption of iodide in both proximal and distal portions of the renal tubules of the dog. (auth)

9834 EFFECT OF MAGNESIUM IONS ON REMOVAL OF RADIOSTRONTIUM FROM RATS. Irwin Clark and Marilyn R. Smith (Columbia Univ., New York). Proc. Soc. Exptl. Biol., Med. 109: 135-9(Jan. 1962).

Magnesium is effective in increasing the elimination of Sr^{89} by rats which had been given the isotope either one or 30 days before treatment. It is effective when given orally or parenterally. Oral administration of magnesium decreases fecal Sr^{89}; however, the sum of urinary and fecal Sr^{89} is significantly greater than those of control animals. Supplementation of magnesium with citrate ions or Prednisolone was no more effective than magnesium alone. (auth)

Fallout and Ecology

9835 SOME FUNDAMENTAL ASPECTS OF MARINE ECOLOGY IN RELATION TO RADIOACTIVE WASTES. Milner B. Schaefer (Scripps Institution of Oceanography, LaJolla, Calif.). Health Phys., 6: 97-102(Oct. 1961).

Discussion is given on marine environment and its subdivisions, including near shore areas, continental shelf and the overlying waters, the deep sea beyond the continental shelf, food web in the sea, uptake and retention of radioisotopes by organisms used as food for man, maximum permissible concentrations in the environment, and effects of organisms on the distribution of elements in the sea.(P.C.H.)

9836 NATURAL AND FALLOUT γ-ACTIVITY IN FOODSTUFFS. A. S. Chhabra and R. K. Hukkoo (Atomic Energy Establishment, Trombay, India). Health Phys., 7: 151-6(Feb. 1962).

A study was undertaken to estimate the actual concentration of γ-active isotopes in vegetables, tea, tobacco, powdered milk, wheat, rice, fish, etc., which are available in Bombay, India. A large-size NaI(Tl) crystal scintillator and a thirty-channel pulse-height analyser were used to identify and to estimate the concentration of the radioisotopes. The studies were carried out over a period of about 15 months, during the year following the stoppage of nuclear weapon tests (in October 1958), the month before the French atomic weapon test in Sahara desert on February 13, 1960, and the month after the French test. In addition to the presence of natural radioactivity of K^{40}, fission product activities such as $Zr^{95}-Nb^{95}$, Ru^{103}, I^{131}, Cs^{137}, $Ba^{140}-La^{140}$, Ce^{141}, and Ce^{144} were noticed, but in varying amounts in different materials. The very high activities of $Zr^{95}-Nb^{95}$ and Ce^{144} in tea were found to be chemically bound in its leaves preventing this uptake by human beings. The presence of $Zr^{95}-Nb^{95}$ in carrots suggests its preferential pick up through the roots. The radioisotope Zn^{65} was detected in fish and prawns. The analysis of certain vegetables during the month following the French test clearly indicated the presence of short-lived fission products which should have originated in the test. The degree of contamination is found to depend upon the total surface offered to the fallout and its roughness to hold the activity. (auth)

9837 STRONTIUM-90 IN UNPROCESSED LIQUID MILK IN THE NETHERLANDS: UPTAKE FROM SOIL AND DIRECT ABSORPTION BY GRASS. F. C. M. Mattern and L. Strackee (National Inst. of Public Health, Utrecht). Nature, 193: 647-9(Feb. 17, 1962).

Investigations into the strontium-90 content of milk show that the level of contamination is not only determined by total cumulative deposits in the soil, but also depends largely on the rate of fall-out, indicating that an important amount results from direct absorption of recently deposited fall-out by the grass mat. Results are given for the years 1959 and 1960 for strontium-90 and 1960 for cerium-137. An equation is described for calculating the strontium-90 uptake from the soil and its feasibility is discussed. The effects of rain water on the strontium-90 levels are also discussed. (N.W.R.)

Radiation Effects on Living Tissues

9838 (ORINS-39) OAK RIDGE INSTITUTE OF NUCLEAR STUDIES MEDICAL DIVISION REPORT FOR 1960.

(Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). Contract AT(40-1)-Gen-33. 78p.

Results and progress in clinical research, medical physics, preclinical research, and training are reported. (M.C.G.)

9839 (TID-14662) THE EFFECTS OF X-IRRADIATION ON THE EMBRYOS OF INVERTEBRATE ANIMALS. Progress Report for Contract Period, May 1, 1961–April 30, 1962. Wesley P. Larsen (College of Southern Utah, Cedar City). Jan. 1, 1962. Contract AT(11-1)-1030. 12p.

Progress is reported on developments in the study of the effects of x rays on Balberus craniifer at various times during the gestation period, which averages 90 days. The events of development are chronologically tabulated. Results show that embryos younger than 28 to 30 days are affected by dosages below 700 r, while embryos older than 30 days are suddenly resistant and continue development until dosages reach the 2000 to 5000 r range. Dosages above 5000 r caused the females to die within 30 days after treatment. (B.O.G.)

9840 (TID-14992) THE EFFECT OF X-RAY IRRADIATION ON THE DESOXYRIBONUCLEIC ACIDS OF THE SPLEEN AND RADIOSENSITIVE TISSUE. Progress Report for the Period from May 1, 1961 through January 31, 1962. Henry P. Schwarz (Philadelphia General Hospital). Contract AT(30-1)-2568. 13p.

Desoxyribonucleic acids (DNA) were prepared with different procedures from spleens of non-irradiated and x-ray irradiated rats (1 hr. after total body irradiation at 1000 r) and then fractionated on ECTEOLA-cellulose columns. It was found that apparently minor changes of the procedure of DNA preparation affected the chromatographic profiles. Despite these variations, however, it was established that the DNA's from the irradiated spleens contained many more fractions, which were eluted earlier from the columns (presumably lower molecular DNA's) than the DNA's from the controls. Estimation of the molecular weight of the fractions by light scattering is still in progress. Infrared spectroscopy of the unfractionated DNA's and of the chromatographic fractions subsequently obtained from them suggested that the ratios of the extinction coefficients of the bands at 9.8 μ (produced by the desoxyribose component) to the bands at 10.3 μ (produced by the C-O-P grouping) may tend to increase toward the less easier eluted fraction. (auth)

9841 (TID-14997) A STUDY OF THE BIOCHEMICAL EFFECTS OF IONIZING AND NONIONIZING RADIATION ON PLANT METABOLISM DURING DEVELOPMENT. Progress Report, May 15, 1961–February 1962. (Smithsonian Institution. Div. of Radiation and Organisms, Washington, D. C.). Contract AT(30-1)-2373. 53p.

Studies on the biochemical effects of radiation on plant metabolism are described. Topics discussed include the effect of ionizing and nonionizing radiation on chlorophyll synthesis, interaction between x-ray-induced chromosome aberrations and far-red radiant energy, effects of cobalt on the yield of oxidative phosphorylation, protein synthesis associated with the formation of the complete photosynthetic system, and kinetics of the light-stimulated growth of etiolated leaf disk and seed germination. (M.C.G.)

9842 (TID-14998) A STUDY OF THE EFFECT OF IONIZING RADIATION ON THE LIPID METABOLISM OF BLOOD AND BONE MARROW CELLS. Annual Progress Report, May 15, 1961 through January 31, 1962. B. Malamos (Athens. Univ. School of Medicine). Contract AT(30-1)-2769. 32p.

The effect of ionizing radiation on leukocytes was studied. It was found that a radiation dose of 1000 r was without effect on the metabolism of leukocyte lipids. It was found that irradiated lipids show a somewhat different pattern of fatty acid composition. When bone-marrow cells were irradiated and incubated with acetate-1-C^{14}, the observed incorporation in comparison with non-irradiated cells, depended on the time lapse between irradiation and incubation. (M.C.G.)

9843 (TID-15000) PRODUCTION AND STUDY OF ASPOROGENIC MUTANTS OF BACILLUS CEREUS. Annual Report, June 1, 1961–May 31, 1962. Donald G. Lundgren (Syracuse Univ., N. Y.). Contract AT(30-1)-2038. 39p.

Investigations were extended as regards the role of calcium and zinc in asporogenic mutants of B. cereus. Calcium alone was capable of controlling the dipicolinic acid synthesis in sporogenic but not in asporogenic cultures. Calcium probably functions in enzymatic reactions leading to the synthesis of dipicolinic acid. The distribution of calcium-45 and zinc-65 in the various chemical fractions of both asporogenic and sporogenic cultures are discussed. Greater percentages of zinc than of calcium were observed in the cold trichloracetic–acid-soluble fraction which may indicate that calcium plays a major role in these organisms other than in the involvement in the metabolic pool. More calcium was associated with the alcohol-soluble, ether-insoluble fraction from spores than from homolgous vegetative cells, while comparative percentages were observed in the mutant before and after abortive sporulation. It is possible that the increased percentages of calcium associated with the fraction from spores are involved in heat stability of proteins. Initial work on the physical characterization of the polymer poly-beta-hydroxybutyrate component of B. cereus and development of a technique for isolating auxotrophic mutants are reported. The use of auxotrophic mutants requiring cystine for studying radiation sensitivity was attempted. (auth)

9844 (TID-15002) ACUTE RADIOSENSITIVITY OF MICE DIFFERING IN W-GENOTYPE. Sheldon E. Bernstein (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.) [1961]. Contract [AT 30-1 -1800]. 6p.

Evidence is presented that a difference of a single gene can alter the ability of mice to survive an exposure to a single large dose of x radiation. The substitution of mutant alleles of the W-series for the normal w clearly decreased the radioresistance of mice in experiments designed so that other variables influencing radiosensitivity would be minimized. Data are tabulated. (C.H.)

9845 (TID-15021) BASIC FERTILIZATION PHENOMENA AND GAMETIC LETHALITY IN DROSOPHILA. Technical Progress Report. (Michigan State Univ., East Lansing). [1962?]. Contract AT(11-1)-1033. 4p.

The processes involved in normal insemination in Drosophila melanogaster are being studied by dissection and observation of the genital tract of inseminated females at intervals following copulation. Movement of the spermatozoa into the ventral receptacle of the female did not seem to be accomplished by swimming action of the sperm, but groups of longitudinally-oriented sperm appeared to be drawn en masse into the ventral receptacle. Definite mating preferences of males and females correlated with strain were noted. Observations of females irradiated after insemination supported the hypothesis that irradiation produces a lethal, rather than merely deleterious, effect on the mature sperm cells. Differential survival of gametes was examined by two genetic techniques. Data from both of the experiments agreed in suggesting an apparent enhancement of radiation damage in stored sperm. (M.C.G.)

9846 (JPRS-11485) CYTOLOGY. Translation of Tsitologiya, 2: No. 6, 625-753(Nov.-Dec. 1960). 175p.

Separate abstracts were prepared for two selected articles. Other articles cover various aspects of cytology and cytochemistry. (C.H.)

9847 (JPRS-11485(p.122-30)) CHANGES IN VITAL STAINING OF TISSUES AFTER TOTAL BODY IRRADIATION OF ANIMALS BY X-RAYS. V. I. Skorik and S. N. Romanov. Translated from Tsitologiya, 2: 710-16(Nov.-Dec. 1960).

Changes were studied in the vital staining characteristics of tissues from mice after exposure to doses of 25 to 700 r x rays. A direct relation was established between the quantity of dye bound by tissue and the radiation dose. A phasic response of tissues to vital staining was demonstrated. It was concluded that the changes in vital staining characteristics are the result of a primary disturbance in metabolic processes induced by x irradiation. (C.H.)

9848 (JPRS-11485(p.158-63)) RESPONSE OF CERTAIN VARIETIES OF WHEAT AND BARLEY TO Co^{60} IRRADIATION. Ya. A. Ivanov and B. N. Kulikov. Translated from Tsitologiya, 2: 736-9(Nov.-Dec. 1960).

Different degrees of radiosensitivity and different frequencies of chromosomal reorganizations were found in different varieties of wheat and barley following exposure of seeds to Co^{60} γ radiation of doses of 500, 4,000, 8,000, and 10,000 r. Data are tabulated. (C.H.)

9849 (JPRS-12003) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, 5: No. 12, 1-97(Dec. 1960). 158p.

A translation is presented of the Russian journal Meditsinskaya Radiologiya 5: (Medical Radiology) No. 12, Dec. 1960. Abstracts of the 13 selections in this issue, covering various phases of radiation sickness and the biological effects of radiation, were previously prepared from the original language and appeared in Nuclear Science Abstracts. (C.H.)

9850 (JPRS-12387) RADIOBIOLOGY. Translation of Radiobiologiya, 1: No. 3, 321-462(1961). 420p.

This is a complete translation of the journal which was previously abstracted for NSA from the original language. (D.L.C.)

9851 (NP-tr-848) EXPERIMENTAL PRODUCTION OF MUTATIONS IN CHRYSANTHEMUM INDICUM BY X-RAYS. H. Jank. Translated by Catherine T. M. Herriott (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Züchter, 27: 223-31(1957). 36p.

Experiments on the production of mutations by means of x irradiation led to the conclusion that this is a certain method of creating new color varieties of Chrysanthemum indicum. The x-ray treatments tested on young plants from cuttings were 1000 r, 1500 r, and 2000 r. The first two doses, in conjunction with adequate cloning, gave the highest absolute number of color changes. Cloning was observed to influence the number of mutations manifested, the number of different color changes, and the form of chimaeric characteristics. Numerous color changes occurred, covering the whole range of colors known for chrysanthemums. The influence of spontaneous somatic mutability, the natural extent of mutative variation within individual color varieties, and the isolation and fixation of new colors in chrysanthemums are discussed. (C.H.)

9852 EFFECT OF IONIZING RADIATIONS ON RICE. Masahide Shiroishi (Ministry of Agriculture and Forestry, Tokyo). Agr. Biol. Chem., 25: 611-15(1961). (In English)

Rice seed and natural brown rice were irradiated with cobalt-60 gamma rays and cathode rays. Development of primary leaf and root was highly inhibited by irradiation more than 5×10^4 rep, whereas the growth of root was somewhat accelerated by 5×10^3 rep. More than 1.6×10^5 rep was necessary for the complete destruction of the germination. Thiamine and riboflavin contents of rice seed irradiated with 10^5 rep of cobalt-60 gamma rays were almost the same magnitude as the non-irradiated one, and 87 to 96% of microorganism on brown rice could be killed with 1×10^5 rep. (auth)

9853 EFFECTS OF THE COMBINED ACTION OF ROENTGEN RAYS AND A CHEMICAL CARCINOGEN (DAB) ON THE RAT'S LIVER. Antoine Lacassagne and Lucienne Hurst (Institut du Radium, Paris). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 536-42 (Mar. 1962).

The effects of increasing doses of x rays and the effects of the combined action of ionizing radiation and a steady diet of p-dimethylaminoazobenzene (DAB) are given. It was found that doses of 500 and 1500 r had no significant effect on rats' livers, but 3000 r was not well tolerated. With the 3000-r dose, atropy and compensatory hypertrophy were present one month later in rats that did not succumb to the dose. In the second experiment it was concluded that malignant transformation under the action of DAB was retarded because of the possible slackening of repair processes by the irradiation which preceded the chemically induced cancer formation. The damage to the hepatic cells by irradiation and DAB did not appear to be additive. (P.C.H.)

9854 THE SYSTEMIC EFFECTS OF LOCALIZED RADIATION ON SERUM PROTEINS IN HUMANS. A PRELIMINARY REPORT. Joseph L. Ackerman, Joseph A. Linsk, and Bernard J. Shuman (Atlantic City Hospital, N. J.). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 543-6(Mar. 1962).

Serum electrophoretic patterns were recorded before and after irradiation of large local blocks of tissue in humans. Of 11 cases, 10 showed a slight to moderate increase in gamma globulin with no consistent change in the other protein fractions. It is suggested that the gamma globulin change represents a stimulation of the plasma cell component of the reticuloendothelial system. The stimulation is most likely a remote effect of the radiation. (auth)

9855 LOW LEVELS OF X-IRRADIATION AND THE EARLY MAMMALIAN EMBRYO. Roberts Rugh (Columbia Univ., New York). Am. J. Roentgenol., Radium Therapy Nuclear Med., 78: 559-66(Mar. 1962).

Newly fertilized eggs of mice or the 1-2 stage (at 24 hr) were x irradiated to low levels of 5 and 15 r, and the embryos and fetuses examined for sequelae. The percentage of early deaths and resorptions was increased over the controls to 19% among those irradiated before cleavage and to 9% among those irradiated during the first cleavage. Exencephaly (brain hernia) was found following only 15 r at both 0.5 and 1.5 days post conception. Even after 5-r exposure there was some evidence of delay in the early cleavages and an increase in the percentage of early abnormals, cytologically determined. Some of the cytologic effects of x rays on the early embryo were: fragmentation, separation of blastomeres, elimination of protoplasm as blebs, elimination of one or both pronuclei, pyknosis of the nuclei, swelling, vacuolization, hyperchromaticity, and staining evidence of phase degeneration. (P.C.H.)

9856 THE INFLUENCE OF THE TIME FACTOR ON THE DOSE-RESPONSE CURVE. Lucille A. Du Sault

(Henry Ford Hospital, Detroit). Am. J. Roentgenol., Radium Therapy Nuclear Med., 78: 567-73(Mar. 1962).

Dose-response curves for the cure of spontaneous mammary adenocarcinomas in C_3H mice by radiation were found to maintain their slope for over-all times of 18 and 25 days, and also for fractions given daily, three times a week, and twice a week. Cure rates are explained qualitatively in terms of treatment dose size, but quantitative examination showed that a given treatment dose becomes more effective with repetition. The oxygen effect is suggested as a possible explanation for this. A possible optimum occurred for small treatment doses given three times a week. (auth)

9857 A CONCEPT OF RADIOSENSITIVITY. J. Robert Andrews (National Institutes of Health, Bethesda, Md.). Am. J. Roentgenol., Radium Therapy Nuclear Med., 78: 601-5 (Mar. 1962).

The basic concept of radiosensitivity is re-examined in the light of theoretic and experimental radiobiological findings available today. Radiosensitivity is redefined as the condition of cell radiation response obtained as a consequence of both intrinsic characteristics and extrinsic conditions. It is felt that the conceptual re-examination of radiosensitivity and its redefinition carry implications for both the theoretic possibility of modifying radiosensitivity and the rational and practical means for so doing. (P.C.H.)

9858 THE CHANGE IN CONTENT OF SULFHYDRYL GROUPS IN PROTEINS OF THE STRUCTURAL ELEMENTS OF RAT LIVER CELLS IRRADIATED WITH ROENTGEN RAYS. B. M. Kedrova, Zh. A. Antokol'skaya, and V. M. Rodionov (Inst. of Biological and Medical Chemistry, Academy of Medical Sciences, Moscow). Biochemistry (U.S.S.R.) (English Translation), 26: 210-12(Sept.-Oct. 1961).

In a short period after irradiation of animals there is a decrease in content of sulfhydryl groups of the water soluble proteins of the cell nuclei in the liver by 20 to 25%. The decreased quantity of sulfhydryl groups in the water soluble proteins of the cytoplasmic elements is noted after a longer period of time. When water solutions of proteins isolated from the structural elements of liver cells are irradiated in vitro, the most marked decrease in quantity of SH groups is found in the proteins of the microsomes (by 47%) and in nuclear proteins (by 25%). (auth)

9859 NUCLEOTIDE METABOLISM OF GALLFRIA MELLONELLA L CATERPILLARS, NORMAL AND AFTER X-RAY IRRADIATION. G. A. Kritskii and Chai Ch'iwei (Bakh Inst. of Biochemistry, Moscow). Biochemistry (U.S.S.R.) (English Translation), 26: 224-7(Sept.-Oct. 1961).

In the composition of the acid soluble fraction of bee moth caterpillars there is found adenosine triphosphate. adenylic acid, and other low molecular weight purine and pyrimidine compounds. A day after x irradiation of the caterpillars with a dose of 2000 r the total extinction of acid soluble compounds at 260 mμ decreases by 7%. The content of ATP falls by about 36%. Autolysis of the caterpillars in orthophosphate buffer solution a day after irradiation with a dose of 2000 r increases by about 86%. A considerable fall in ATP content and activation of autolysis in the period immediately after irradiation can be explained by the inhibition of oxidative phosphorylation after irradiation. (auth)

9860 THE EFFECT OF IRRADIATION ON MAGNESIUM CONTENT OF RAT LIVER. G. A. Kochetov (Moscow State Univ.). Biochemistry (U.S.S.R.) (English Translation), 26: 287-9(Sept.-Oct. 1961).

Whole-body irradiation of rats in doses of 600 and 900 r brought about an increase in liver Mg. Addition of Mg to extracts of liver from unirradiated animals results in the same interference with ribose-5-phosphate metabolism observed in extracts of liver from irradiated animals. (auth)

9861 THE RELATION BETWEEN CELL DIVISION AND CELL DEATH AFTER IRRADIATION. John Read (Wakari Public Hospital, Dunedin, N. Z.). Brit. J. Radiol., 35: 218-19(Mar. 1962).

Experiments were made to test the hypothesis that cells injured by irradiation do not die until a subsequent division. The anterior lobes of rats' livers were brought outside their bodies through abdominal wall incisions and given 5000 r of x rays with the rest of the body shielded. At chosen times up to three months after irradiation, cell division was provoked in the irradiated lobes. When mitosis was stimulated, cells in the irradiated zone showed chromosome bridges and fragments, and coincident with the mitotic activity degenerate cells appeared. It is concluded that at first view, these experiments appear strongly to support the truth of the hypothesis. Discussion is given on the effects of weight changes in the lobes on the hypothesis. (P.C.H.)

9862 THE EFFECT OF X-RADIATION ON THE SUCCINIC DEHYDROGENASE ACTIVITY OF THE DIVIDING STAGES OF TETRAHYMENA PYRIFORMIS GL. William D. Sullivan, S. J. Boyle, and James V. Boyle (Boston Coll., Chestnut Hill, Mass.). Brotéria, Ser. ciênc. nat., 30: No. 3-4, 77-85(1961). (In English)

Tetrahymena pyriformis was grown in a chemically defined medium. Synchronous division was induced by the temperature flux method. The succinic dehydrogenase activity was tested by Thunberg technique in both control and irradiated cultures of each stage of division. The control cultures immediately after the shock treatment and 150 minutes after the treatment (during the actual division of the cell) manifested a significant inhibition of enzyme activity. In these same stages, activity was accelerated when the organisms were irradiated. (auth)

9863 CONTRIBUTION TO THE EXPERIMENTAL RADIOBIOLOGY OF TUMORS. EFFECT OF IRRADIATED CELLS ON VIABLE CELLS IN THE GUERIN T8 ATYPICAL EPITHELIOMA IN THE WISTAR RAT. J. Jacquet, G. Letourneur, P. Jacob, and S. Abbatucci (Faculté des Sciences, Caen and Centre Régional de Lutte Contre le Cancer, Caen). Compt. rend. soc. biol., 155: 1248-51 (1961). (In French)

As a preliminary step in the determination of the effect of irradiated cells on viable cancerous cells, the sterilizing dose for metastasized lymphatic ganglions was determined from the number of grafts obtained from the irradiated cells. A dose of 5000 r inhibits in vitro the cancerous cells. In the second series of studies, the cells irradiated with 5000 r were mixed with different amounts of viable cells, and the number of resulting grafts was determined. The results show the irradiated cells cause a definite inhibition of the activity of the viable cells with respect to grafting. The frequency of epitheliomas obtained is proportional to the relative quantity of active inoculum placed under the skin. Also, the course of the grafted tumors varies with the proportion of sterilized cells used. (J.S.R.)

9864 EFFECTS OF GAMMA RADIATION ON OXYGEN UTILIZATION, IODINE METABOLISM AND LEUCINE INCORPORATION BY SURVIVING SHEEP THYROID TISSUE

SLICES. J. Barzelatto, I. P. C. Murray, and J. B. Stanbury (Harvard Medical School, Boston and Massachusetts General Hospital, Boston). Endocrinology, 70: 328-32(Mar. 1962).

The immediate effects of high energy gamma radiation derived from a Co^{60} source were studied on oxygen utilization, iodine metabolism, and leucine incorporation into protein in surviving sheep thyroid tissue slices. Radiation in doses up to 500,000 rads failed to have any noteworthy effect on oxygen intake. Leucine incorporation was reduced to approximately 50% by 75000 rads. Incorporation of iodide into protein was reduced to 50% of control value by 200,000 rads. Iodide trapping was less sensitive to radiation than was iodide incorporation. The ratio of monoiodotyrosine to diiodotyrosine formation in the tissue slices increased with increasing radiation. (auth)

9865 CYSTEAMINE–OXYGEN ANTAGONISM IN THE RADIATION EFFECT ON T2-BACTERIOPHAGES. G. Hotz (Institut für Strahlenbiologie am Kernforschungszentrum, Karlsruhe, Ger.). Experientia, 17: 498-9(1961). (In German)

T2 phage suspended in broth and irradiated in the presence of cysteamine in high concentration is protected against the action of x rays equally well under oxygen as under nitrogen. Low concentrations of cysteamine, however, give protection under nitrogen only. These results resolve apparent contradictions in earlier work and lend support to the mechanism of reaction as proposed by Howard-Flanders. (auth)

9866 THE EFFECT OF ULTRAVIOLET TREATMENT ON THE SURVIVAL RATIOS OF X-IRRADIATED MICE. K. Rák, F. Krizsa, E. Soevenyi, and I. Cserháti (Szeged, Hungary). Experientia, 17: 518-19(1961). (In German)

Whole body x ray irradiation (300 r) of mice did not decrease the circulating platelet count, if this dose was preceded by 24 h of ultraviolet irradiation. More animals survived the x-ray (500, 550, 600 r) injury, if the irradiation occurred after ultraviolet treatment given 24 and 48 h before. The number of days survived is also increased. The ultraviolet light seems to have some protective effect against injury caused by x ray. (auth)

9867 INDUCTION OF PATERNAL SEX CHROMOSOME LOSSES BY IRRADIATION OF MOUSE SPERMATOZOA. Liane Brauch Russell and Clyde Lee Saylors (Oak Ridge National Lab., Tenn.). Genetics, 47: 7-10 (Jan. 1962).

Paternal sex-chromosome loss, both partial and complete, was induced by irradiation of mouse spermatozoa, 600 r giving an induced frequency of at least 1.2% of daughters hemizygous for a marker on the maternal X. Comparison with dominant lethal frequency indicated that sensitivity of the sex chromosomes is probably not too unlike that of autosomes. Comparison between the induction of paternal sex-chromosome loss in spermatozoa, on the one hand, and in the male pronucleus shortly after sperm entry into the oocyte, on the other, indicated the latter stage to be more sensitive by approximately one order of magnitude. (auth)

9868 MODIFICATION OF V-TYPE POSITION EFFECTS IN DROSOPHILA VIRILIS. Imogene Schneider (Univ. of Chicago). Genetics, 47: 25-44(Jan. 1962).

A series of six translocations, each of which evokes a position effect of the peach locus (chromosome 5) in D. Virilis, were studied to determine whether the parental source of $R(pe^+)$ had any influence on the amount of pigmentation in the heterozygous variegated offspring. Utilizing paper chromatography, quantitative measurements were made on the drosopterins and a number of other pteridines, some of which presumably act as intermediates in the synthetic pathway leading to the formation of the red pigments. Measurements were made on the eyes of both male and female offspring, and on the testis sheaths of the males. Without exception, heterozygous variegated offspring are more highly pigmented if $R(pe^+)$ is transmitted by a homozygous female parent in contrast to a heterozygous female, homozygous or heterozygous male parent. Homozygous male parents usually produce more highly pigmented offspring than do heterozygous male parents. In addition, mottled offspring receiving $R(pe^+)$ from heterozygous mothers often have more pigment than the corresponding offspring receiving $R(pe^+)$ from heterozygous fathers. These statements are true only so far as the visible pigments (drosopterins) are concerned. The other pteridines, in contrast, show no consistent pattern as to the parental source of the translocation. With respect to one of the Y;5 translocations studied, the presence of a Y chromosome in the genome of the mother suppressed the phenotypic expression of mottling in her male offspring, even though they did not receive this chromosome. Paralleling this is the fact that the addition of an extra Y chromosome to the genome of these flies led to an even greater suppression of variegation, a finding inconsistent with the generalization that extra heterochromatin enhances the extent of mottling in V-type position effects associated with genes located in heterochromatin. (auth)

9869 BIOLOGICAL DAMAGE IN THE MATURE SPERM OF DROSOPHILA VIRILIS IN OXYGEN AND NITROGEN WITH DIFFERENT DOSE INTENSITIES OF GAMMA RAYS. Mary L. Alexander and Janet Bergendahl (Univ. of Texas, Houston). Genetics, 47: 71-84(Jan. 1962).

Modifications in the percentages of dominant lethal and translocation damage were not obtained by varying the dose rate of gamma rays in treatments of mature sperm of Drosophila virilis. Nineteen experiments in five series of tests were performed using radiation dose rates from 50 to 2000 r/minute or two fractionated doses divided by periods of from 15 to 60 minutes. The dose rates of gamma rays did not modify the amount of two break, reattachment types of chromosome damage, translocations, or dominant lethal damage when treatments were made in either a completely oxygen-saturated atmosphere or an anoxic atmosphere of nitrogen. Postirradiation recovery periods were not detected by testing with alternate radiation treatments in oxygen and nitrogen. Different time intervals of 15 to 40 minutes between treatments failed to produce modifications in the percentages of dominant lethals. Therefore, there is no indication of a postirradiation time limit for recovery mechanisms in Drosophila sperm. In all the radiation tests using mature sperm of Drosophila virilis, the genetic damage was characterized by the induction of genetic damage which was not modified by the dose rate tested in external environments of oxygen or anoxic atmospheres of gases. The possibility of genetic repair mechanisms operating after chronic doses of radiations of spermatogonial cells and postirradiation effects in metabolically active cells are discussed briefly. (auth)

9870 COMPARATIVE STUDIES OF CYTOCHROME C OXIDASE ACTIVITY AND MUTABILITY IN TWO STRAINS OF DROSOPHILA. Calvin L. Ward and Margaret A. Bird (Duke Univ., Durham, N. C.). Genetics 47: 99-107(Jan. 1962).

A comparative study of the cycles of cytochrome c

oxidase activity during pupal and adult life of two strains of Drosophila showed that the cycle of enzyme activity in the more rapidly developing strain precedes the slower strain, thus alternating the relationship of the enzyme activity during the time of development of the irradiated germ cells. The relationship of the differences in radiation sensitivity of the developing cells to the enzyme cycles is discussed. It was necessary to postulate at least two factors other than the protective effect of the cytochrome system in order to explain the entire sensitivity pattern of the two strains. (auth)

9871 R-LOCUS DELETERIOUS FACTORS IN MORMONIELLA. P. W. Whiting (Univ. of Pennsylvania, Philadelphia). Genetics, 47: 115-29(Jan. 1962).

New data are presented on 37 R-locus mutant genes containing deleterious factors or crossover suppressors. Twenty-seven of these genes are among the 206 recognizable eye-color mutants previously found by others in experiments in which wild-type males were irradiated and mated, siring 11062 daughters examined, mutation rate 1.86%. With the addition of eight mutants from later similar tests there were 38 mutants failing to breed, probably being dominant steriles, and seven immature, probably dominant lethals. Of the 160 mutants given successful breeding test, 80 were normal and 80 contained deleterious factors of different types—lethals, near-steriles, female-steriles, and male-steriles. Rate of deleterious factor production differs according to the factor mutating to produce the eye-color marker. Among the 107 genes changed in factor S alone, 68 were also deleterious (63.6%) but for the 45 in O, there were only nine (20.0%), suggesting a more sensitive region near S. More than one deleterious factor may be produced simultaneously with an eye-color change and one defect may mask others. The gene which forms a temporary unit of segregation in heterozygotes is of a higher order of magnitude than units of heredity (gene elements, cistrons) which may be permanently present in the germ plasm. Because of the high mutation rate to the marker eye colors scarlet and oyster white, the genetical structure of the R region may be easily studied. (auth)

9872 THE EFFECT OF WHOLE BODY X-IRRADIATION ON THE BLOOD AND OTHER TISSUES OF WHITE LEGHORN COCKERELS. R. L. Atkinson, J. H. Quisenberry, A. B. Medlen, and G. Berger (Agricultural and Mechanical Coll. of Texas, College Station). Health Phys., 6: 163-76(Oct. 1961).

White Leghorn cockerels were given levels of whole-body x irradiation ranging from 50 to 500 r at 6, 12, and 18 weeks of age. The irradiation was given at 160 kv, 10 ma, and with a target distance of 20 in. Blood samples were taken at 1, 3, 8, and 18 days after irradiation and were used to determine total red cell count, total white cell count, hemoglobin, and white cell differentials. Irradiated birds not used for blood counts and hemoglobin determinations were sacrificed at 1, 3, and 5 weeks after irradiation in order to study the effects of irradiation upon certain tissues. All of the blood data indicate that in general the cockerel reacts to x irradiation in a manner similar to other animals. The large number of basophils in the peripheral blood make the animal an excellent subject for a study of the effect of irradiation on this particular cellular element. Tissue damage was found to be similar to that reported for other animals. Irradiation damage was manifested in the seminiferous tubules of the testes as follows: sperm scattered among the cells comprising the tubular walls; a decrease in the number of sperm attached to Sertoli cells; sperm oriented in an abnormal manner; the presence of cell necrosis; and a massive sloughing of cells in the tubules. (auth)

9873 A FIRST REPORT ON THE MUTATIONS PRODUCED BY X-RAYS ON SWEET POTATOES. Ching-San Liao and Hwei-Ping Cheng. Ho Tsu K'o Hsueh, 2: No. 2, 57-9(1958). (In Chinese)

Fifty root stocks of a special breed of sweet potatoes, a disease-resisting and early-ripening type designated P_{30}, were irradiated with x-rays. Half (25) of the roots were irradiated with x rays of 1250 γ and half with 5000 γ. All irradiated plants produced mosaic leaves of purple and green. The leaves of the control plants were purple. The root stock of the treated plants had red skin whereas the control plants had root stocks with white skin. The harvest of the irradiated plants varied from 0 g. (one plant died) to 2320 g. whereas the harvest of the control plants varied from 190 g. to 1875 g. The effect of x-rays on the plants varied not only according to dosage but also to the stage of germination of the plants. (TTT)

9874 THE CURRENT STATE OF THE PROBLEM ON PREVENTION OF RADIATION INJURY OF THE FETUS. N. A. Kalinina (Inst. of Experimental Medicine, Academy of Medical Sciences, USSR). Med. Radiol., 6: No. 12, 68-71(Dec. 1961). (In Russian)

A survey is made of the protective effects of cysteamine, mercamine, and other prophylactic preparations against the mortality and deformation of fetuses during various stages of pregnancy in animals. The prophylaxis and therapeutic effects of bone marrow implantation are also discussed. (R.V.J.)

9875 THE EFFECT OF WHOLE-BODY X-RAY IRRADIATION ON THE ABSORPTIVE AND SECRETORY FUNCTION OF THE INTESTINE. I. Ya. Nekachalova. Med. Radiol., 6: No. 12, 72(Dec. 1961). (In Russian)

Whole-body irradiation of dogs suffering from intestinal fistula showed prolonged disturbance and depression in absorptive and secretory functions of the large and small intestines. Identical doses produced identical effects in the small and large intestine. (R.V.J.)

9876 ON THE LEUKOCYTIC REACTION AND IMMUNOLOGICAL INDICES IN RABBITS SUBJECTED TO THE ACTION OF X-RAYS. T. G. Starkova, E. P. Shuvalova, V. M. Soldatova, and T. V. Tkacheva. Med. Radiol., 6: No. 12, 76-7(Dec. 1961). (In Russian)

The influence of x radiation (500 r) on various immunobiological reactions in rabbits (leukocyte reactions, plasma stability, serum fraction, and aglutaric, complementary, and preventive properties) was studied. The results show a reduced number of leukocytes accompanied by a reduced number of phagocytes in relation to dysentery and typhoid bacteria. Plasma stability is disturbed by a reduction in albumin and an increase in α globin. However, the blood serum in irradiated animals retained its preventive properties with reduced titer. (R.V.J.)

9877 BLOCKING OF IMMUNOGENESIS BY MEANS OF IRRADIATION AND PASSIVE SPECIFIC IMMUNITY. V. F. Sosova. Med. Radiol., 6: No. 12, 77(Dec. 1961). (In Russian)

The exposure of rabbits to 800 r $LD_{30/30}$ delayed for 2 weeks the production of antibodies and depressed the immunogenesis factors. (R.V.J.)

9878 RESPONSE IN THE PERIPHERAL BLOOD OF TOTAL-BODY IRRADIATED CHICKENS FOLLOWING OXYTETRACYCLINE (OTC) ADMINISTRATION. P. Mach, J. Surynek, and J. Krul (Veterinary Coll., Brno). Nature, 193: 459-60(Feb. 3, 1962).

Experimental results show that oxytetracycline has a positive effect on recovery from post-irradiation leucopenia. Oxytetracycline also manifests itself by suppressing the areas of active tissue of the liver while it causes an activation of follicles in the spleen. The reactions in the liver and the spleen may be viewed from the fact that blood formation in chickens does not take place in all hematopoietic organs with equal intensity, therefore the hematopoietic-stimulating substances may assert themselves as activators at one time and in a paradoxical manner at another time. (N.W.R.)

9879 STIMULATING EFFECT OF OXYTETRACYCLINE ON SOME FRACTIONS OF BLOOD PLASMA PROTEINS IN IRRADIATED CHICKENS. P. Mach and J. Surynek (Veterinary Coll., Brno). Nature, 193: 460 (Feb. 3, 1962).

The stimulating effect of oxytetracycline is evident in the fraction β-globulins plus fibrinogen in both irradiated and non-irradiated chickens and in the γ-globulins of the irradiated chickens. In the other fractions of the blood plasma proteins the administration of oxytetracycline did not manifest itself. The active share of oxytetracycline in the transformation of blood plasma proteins is an indirect one and the mechanism is not fully understood. (N.W.R.)

9880 AN X-RAY-INDUCED STRAIN OF RING-OF-12 IN TRADESCANTIA PALUDOSA. Hiroshi Watanabe (Kyushu Univ., Fukuoka). Nature, 193: 603(Feb. 10, 1962).

A strain showing the ring-of-12 in Tradescantia paludosa ($2n = 12$) was obtained by repeated treatment of the resting axillary buds with x rays. Cuttings with all the branches removed were irradiated with 5,000 or 10,000 r, and chromosomally aberrant new branches were selected and cloned by cuttings. In this way, 43 reciprocal translocation strains were obtained, and some of these strains were irradiated for a second time with 10,000 r to give more complicated strains with larger rings. A ring-of-12 strain was obtained after a third 10,000-r irradiation of the 2 ring-of-6 strain. (D.L.C.)

9881 MUTATIONS INDUCED IN THE MOUSE WITH TRITIATED THYMIDINE. A. J. Bateman and Ann C. Chandley (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Nature, 193: 705-6(Feb. 17, 1962).

The progression of spermatogenesis in the mouse is studied with respect to the effect of tritiated thymidine solution on the maturing sperm. A table is presented which makes a comparison of the daily changes in tritium labeled sperm and the dominant lethal mutations per sperm. The results show that tritiated thymidine is mutagenic for the nuclei of the incorporating deoxyribonucleic acid, and that it requires a concentration of tritium which gives 25 grains per sperm in three weeks' exposure to produce one dominant lethal mutation per sperm. The number of transmutations in the five week period to mating is $100/40 \times 5/3$ times the number of grains. From this it appears that only about one per cent of the transmutations of tritium incorporated into DNA thymidine produces a dominant lethal mutation. The dose is chronic and partitioned between spermatocytes, spermatids, and sperm in the ratios of approximately 2:1:2. (N.W.R.)

9882 TOTAL-BODY IRRADIATION AND MANGANESE METABOLISM. Edwin R. Hughes, George C. Cotzias, and Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). Nature, 193: 792-3(Feb. 24, 1962). (BNL-5763)

Male mice were exposed to 750 rad Co^{60} gamma radiation at a dose rate of 28.3 rad/min, either concomitantly with or 48 hr before or after an intraperitoneal injection of 0.5 μc of $Mn^{54}Cl_2$. The total-body turn-over of Mn^{54} was followed for two weeks, and then the mice were killed and the isolated organs assayed for radioactivity. The Mn^{54} turn-over rate was faster in the irradiated mice than in the controls, regardless of whether the tracer was administered before or after irradiation. The carcass-to-liver Mn^{54} ratio was the same as the controls in the case where the tracer was administered before irradiation and diminished where the administration was made after irradiation. The results are in contradiction with previous studies of the effects of glucocorticoid hormones. (D.L.C.)

9883 EXCESSIVE VARIATION IN RADIATION-INDUCED CHROMOSOME ABERRATIONS. Nathan Mantel and Charles L. Greenblatt (National Institutes of Health, Bethesda, Md.). Nature, 193: 795-6(Feb. 24, 1962).

It has been observed that the number of radioinduced chromosome aberrations in mammalian cell cultures did not follow the anticipated Poisson distribution law; the variance is consistently greater than the average number of aberrations at each dose level. The fact that the dispersion increases with the dose level rules out multi-aberration processes as a cause of the excessive variation. The most probable cause is the varying radiation sensitivity of cells in different growth stages in a mixed population. (D.L.C.)

9884 THE MODIFICATION OF THE FINE STRUCTURE OF IRRADIATED LIVER CELLS. Hildegard Braun and Johannes Mueller (Universität, Freiburg i. B. and Heiligenberg-Institutes, Heilingenberg, Ger.). Naturwissenschaften, 48: 679(1961). (In German)

A study was made to determine at what place in the liver parenchym cells at sublethal and lethal doses the radiation damage in the ultra-structural range is first morphologically detectable, and whether the succession of structure changes always follows the same path. Mice were irradiated with doses of 800, 3200, 6400, and 9600 r and then sacrificed after 30 min, and 6, 12, and 24 hrs. The results showed that first a damage to the ergastoplasmatic structure and a compression of the cytoplasm occurs. The mitochondria undergoes for the most part a transient surface change (formation of lumps). Size and interior structure were first altered usually at 800 and 3200 r after 12 hrs, whereas at 6400 r and above all at 9600 r size increase and structure damage occurred 30 min after the irradiation. At 800, 3200, and partially at 6400 r, the cavity of the endoplasmatic lamella swell independently and chronologically before the mitochrondria. (J.S.R.)

9885 OXYGEN SATURATION AND DRY SEED IRRADIATION. A. T. Natarajan and Gunnar Ahnstroem (Univ. of Stockholm). Naturwissenschaften, 48: 698-9 (1961). (In English)

Dormant seed of diploid barley with two different moisture contents (4 and 11%) were saturated with oxygen by storing them under high oxygen tension (70 atm.) for eight hours and then irradiated with different doses of γ rays from a 3000-curie source at a dose rate of 700,000 rad/hr. Seeds were also irradiated without oxygen saturation with gamma rays and neutrons. The seeds were hydrated immediately after the irradiation and grown under constant temperature. Seedling height reduction in 7-day old seedlings were taken as an index of radiation damage. A 50% growth reduction was attained with 8 krad from seed irradiated after oxygen saturation, 16 krad from irradiation without oxygen saturation and aerobic hydration, 30 krad

from irradiation in air and hydration under anaerobic conditions, 70 krad from irradiation in nitrogen and anaerobic hydration, and 1 krad from neutron irradiation. It was observed that seeds are saturated with oxygen in about 8 hrs. The most interesting point observed in gamma irradiation of oxygen-saturated seeds was the extreme uniformity of the seedling height, indicating that oxygen leads to a homogeneous response. (J.S.R.)

9886 INVESTIGATIONS ON THE STERILIZATION OF PERNICIOUS INSECTS WITH IONIZING RADIATIONS. B. Baccetti (Stazione di Entomologia Agraria, Florence) and M. Cappellini. Nuntius Radiol., 27: 600-3(July 1961). (In Italian)

Referring to the known results obtained by the use of ionizing irradiations in the fight against some harmful insects, an analogous research of the olive fly was carried out. The insect at the pupa stage was irradiated at high doses by means of gamma rays from a Co^{60} source. After establishing the dose sufficient to make the males sterile without depriving them of their capacity of copulation, the ratio between irradiated and normal males necessary to obtain an almost complete sterilization of an environment infested with the olive fly was obtained. (auth)

9887 THE EFFECT OF CONTINUOUS ANTIBIOTIC FEEDING ON X-IRRADIATION MORTALITY IN MICE. W. H. Linkenheimer and H. Berger (American Cyanamid Co., Pearl River, N. Y.). Proc. Soc. Exptl. Biol. Med., 108: 676-80(Dec. 1961).

X irradiation significantly increased mortality over control mice during a 40 week period. Chlortetracycline administered in the feed at 20 parts per million significantly decreased irradiation mortality during the first 20 weeks of the experiment. The marked chlortetracycline effect was due to modification of disease primarily due to Bartonella muris infection. The lesser effect on mortality observed was probably due to antibacterial activity of the chlortetracycline on minor incident infections antagonized by the x irradiation. (auth)

9888 EFFECT OF LOCAL X-IRRADIATION ON GROWTH CAPACITY OF MOUSE KIDNEY. Robert L. Straube and Harvey M. Patt (Argonne National Lab., Ill.). Proc. Soc. Exptl. Biol. Med., 108: 808-10(Dec. 1961).

In adult female CF no. 1 mice, kidney enlargement after unilateral nephrectomy is a consequence mainly of hypertrophy. New cell formation as evidenced by an increase in total DNA content of the kidney may be a contributing factor in young animals but this becomes negligible with increasing age. The compensatory response occurring after uninephrectomy in the adult mouse is quite radioresistant, whether irradiation occurs immediately or 5 days postoperatively. This contrasts with the well-known radiosensitivity of cell renewal systems. (auth)

9889 EFFECT OF IONIZING RADIATIONS ON THE BIOGENESIS OF KARYOKINESIS. INVESTIGATION ON EMBRYONIC CELLS IN VIVO. L. Verga and F. Coucourde (Università, Pavia, Italy). Radiobiol. radioterap. e fis. med., (3) 16: 243-52(1961). (In Italian)

The interference of x rays with the biochemistry of the karyokinesis of megaloblasts in the chicken embryo was examined. The action of glycolysis was studied. It was observed that the preventive administration of phosphorylated glycides diminishes the reduction of the karyokinetic activity of the x rays. The preventive administration of ATP and even more of ATP + DPN keeps the values of the karyokinetic activity normal. Owing to these results the possibility of a direct interference of the x rays with the enzymic activities of the glycolytic cell processes was predicted. (auth)

9890 THE MODIFICATIONS INDUCED BY ARTIFICIAL HIBERNATION IN THE RADIOSENSITIVITY OF MAMMARY TUMORS TRANSPLANTED IN MICE. R. Miceli, A. Corinaldesi, and I. Paoletti (Università, Bologna). Radiobiol. radioterap. e fis. med., (3) 16: 253-65(1961). (In Italian)

Graduated doses of meso-contact-x-ray therapy (1000, 4000 and 5000 rads) were administered. It was found that radioprotection, already observed for healthy tissues, is true also for neoplastic ones. (auth)

9891 STRUCTURE AND STABILITY OF CHROMOSOMES IN THE IRRADIATED CELL. Dale M. Steffensen (Brookhaven National Lab., Upton, N. Y.). p.1460-5 of "Recent Advances in Botany." Toronto, University of Toronto Press, 1961. (BNL-4999)

Chromosomes of higher plants and animals have been shown to be multi-stranded structures by a number of electron microscope studies. Chromosome breakage and mutational events must be interpreted in the light of these findings. Some evidence and theory are presented to explain the aggregation and orientation of macromolecules into chromosomes, taking into account four or five kinds of secondary chemical bonds. Undoubtedly the most important of these cohesive forces are hydrogen bonds, ionic bonds (salt links), and metal complexes. The presence of divalent metal ions, particularly calcium, is considered essential in chromosome stabilization. Special consideration is given to the analysis of dose curves and temperature effects in radiation-induced chromosome aberrations of Tradescantia that were x-rayed in the absence of oxygen. The restitution and rejoining of broken chromosome ends can be considerably altered by temperature. Apparently more intrachanges than interchanges are induced at low temperature, indicating a non-random exchange process. At high temperature the proportion of interchanges increases, suggesting a more random rejoining of breakage ends. Any theory of chromosome rejoining should consider the state of chromosome movement. Many physical or chemical treatments may in fact change the relative movement of broken chromosome ends and thereby alter their frequencies of restitution. (auth)

9892 ISSLEDOVANIE RANNIKH REAKTSII ORGANIZMA NA RADIATSIONNOE VOZDEISTVIE. (Investigation of Early Reactions of Organisms to Radiation Effect). G. M. Frank, ed. Moscow, Publishing House of the Academy of Sciences, 1960. 222p.

Nine articles are included on radiation effects on complex multicellular and high organisms. Separate abstracts have been prepared for eight; one article was previously abstracted in NSA. (R.V.J.)

9893 EFFECTS OF RADIATION DISTURBANCES ON ORGANISMS. G. M. Frank. p.5-13 of "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie." Moscow, Publishing House of the Academy of Sciences, 1960. (In Russian)

Primary processes in functional and pathological disturbances induced by local and whole-body exposure are analyzed, and the relation between local injuries and organism reactions are discussed. (R.V.J.)

9894 THERMODYNAMIC DISTURBANCES IN RADIATION INJURIES. Yu. G. Nefedov. p.14-41 of "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie." Moscow, Publishing House of the Academy of Sciences, 1960. (In Russian)

The response of the vascular system to irradiation is investigated, and hemodynamic indicators describing various functions of the blood circulating apparatus (arterial blood pressure, circulating blood volume, pulse wave distribution rate, and blood viscosity) are correlated in order to present a more detailed picture of radioinduced hemodynamic disturbances. Studies were also made of hemodynamic disturbances during the irradiation of various topographoanatomical regions. The data confirm fast hemodynamic disturbances and the participation of a reflex mechanism in the disturbances. (R.V.J.)

9895 X-RAY EFFECTS ON THE ELASTICITY AND HYSTERISIS OF ELASTIC TYPE ARTERIES. A. I. Polivoda. p.42-59 of "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie." Moscow, Publishing House of the Academy of Sciences, 1960. (In Russian)

Studies were made of the elasticity and other mechanical properties of blood vessels in animals following whole body exposure to a single massive dose. The results show hardening of the arteries and an increase in the elastic hysteresis loop of the vessel wall with maximum hardening in 9 to 19 days. The elasticity changes in other vessels reach a maximum simultaneously with the hemorrhaging stage. (R.V.J.)

9896 HEMODYNAMIC SHIFTS AND CHANGES IN MECHANICAL PROPERTIES OF BLOOD VESSELS IN TOTAL OR LOCAL IRRADIATION. L. G. Veize and G. M. Frank. p.60-82 of "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie." Moscow, Publishing House of the Academy of Sciences, 1960. (In Russian)

The subcutical absorption of soft x rays resulted in hemodynamic disturbances with a drop in the blood pressure. Administration of novocain inhibited the reaction, indicating the inportance of cutaneous nerves in the reflex mechanism that induces the blood pressure decrease. It is also shown that direct effects of irradiation induce mechanical disturbance in the blood vessels in addition to the secondary effects related to the general development of radiation sickness. (R.V.J.)

9897 CHANGES IN PHYSICO-CHEMICAL PROPERTIES OF ERYTHROCYTES EXPOSED TO RADIATION. A. G. Gamburtseva. p.83-92 of "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie." Moscow, Publishing House of the Academy of Sciences, 1960. (In Russian)

Radioinduced physico-chemical changes in erythrocytes of exposed animals were investigated, and continuous changes in the red blood were observed in animals suffering from radiation injuries. (R.V.J.)

9898 ALBUMEN FRACTIONS IN BLOOD PLASMA OF ANIMALS IRRADIATED BY VARIOUS X-RAY DOSES. V. D. Blokhina. p.93-112 of "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie." Moscow, Publishing House of the Academy of Sciences, 1960. (In Russian)

A considerable hypoproteinenemia with reduced albumen fraction and considerable increases in α and β globulin was observed in irradiated dogs and rabbits. The content of γ globulin remained unchanged. It was also observed that the time of blood transfusion plays an important part in the outcome of the radiation injuries. (R.V.J.)

9899 EFFECTS OF X RAYS ON THE GAS BALANCE IN BLOOD. I. V. Vysochina. p.113-24 of "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie." Moscow, Publishing House of the Academy of Sciences, 1960. (In Russian)

X-radiation effects on the gas balance in the blood in acute injuries (1100 r) in rabbits were studied. The changes in oxygen and carbon dioxide levels in the brain vessels were determined as well as the oxygen content of the blood. (R.V.J.)

9900 PECULIARITIES OF PHYSICO-CHEMICAL SHIFTS IN CENTRAL NERVOUS SYSTEM AT VARIOUS RADIATION REACTION PERIODS. N. A. Aladzhalova. p.167-221 of "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie." Moscow, Publishing House of the Academy of Sciences, 1960. (In Russian)

The electrical properties and processes in tissues of animals in vivo were studied in order to determine the dynamics of physico-chemical changes in irradiated animals. An analysis was made of the effects on isolated muscle and on electrical processes in the cerebral cortex during latent and active periods. (R.V.J.)

9901 BIOLOGICHESKOE DEISTVIE RADIATSII I VOPROSY RASPREDELENIYA RADIOAKTIVNYKH IZOTOPOV. (Biological Effects of Radiation Effects and Problems in Radioisotopic Distribution). A. V. Lebedinskii and Yu. I. Moskalev, eds. Moscow, Gosatomizdat, 1961. 192p.

Twenty papers are included; separate abstracts have been prepared for 19. One paper was previously abstracted in NSA. (R.V.J.)

9902 RADIOINDUCED METABOLISM IN NUCLEOPROTEINS, NUCLEIC ACIDS AND THEIR PRODUCTS. T. N. Rysina. p.9-17 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Quantitative changes in nucleoproteins, nucleic acids, nucleotides, and nucleosides in bone marrow, spleen, lymph, appendix, small intestine, liver, and blood of animals irradiated to a total dose of 1000 r at 12 to 16 r/min are described. (R.V.J.)

9903 CHANGES IN BLOOD PICTURE OF RABBITS FOLLOWING CHRONIC EXPOSURE TO γ IRRADIATION. L. V. Bogatov and N. A. Koshurnikova. p.29-37 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Pathological blood picture changes were studied in 6- to 7-month-old rabbits exposed to chronic (30 r) γ irradiation to total doses of 210, 420, 630, 900, 1410, 1920, and 2490 r. The results of histological studies of the brain, spleen, and lymph nodes are tabulated, and the dynamics in peripheral blood changes are analyzed. (R.V.J.)

9904 INVESTIGATIONS OF THE FUNCTIONAL CONDITION OF THE BLOOD SYSTEM IN DOGS EXPOSED TO CHRONICAL IONIZING RADIATION. L. V. Bogatov and Z. I. Kalmykova. p.38-48 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Hematopoietic system reactions to 18 r/day doses of radiation to a total dose of 954 r and to incorporation of plutonium were studied by a method of functional loading. Charts are given of the alterations taking place in the bone marrow after acute bleeding and of the blood picture following repeated bloodletting. (R.V.J.)

9905 THE INFLUENCE OF BONE MARROW TRANSPLANTATION TIME IN ACUTE RADIATION THERAPY. S. A. Rogacheva. p.49-54 of "Biologicheskoe Deistvie

Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Therapeutic effects of normal bone marrow injections in rats irradiated with 1000 r were studied at various intervals following exposure. The best therapeutic effect was observed 24 hours following exposure (60 day survival of 83.6%). Applications of bone marrow 6 to 12 days following exposure showed no beneficial effects. Injections of bone marrow did not stop destructive processes but improved the rate of quantitative restoration of peripheral blood. (R.V.J.)

9906 EXPERIMENTAL DATA ON MAXIMUM PERMISSIBLE LEVELS OF Sr^{90} IN ORGANISMS. Yu. I. Moskalev. p.55-69 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Data on the effects of Sr^{90} on longevity, development of tumors in bone tissues and hametopoietic system, and other somatic reactions in rats and other animals were correlated in order to evaluate permissible doses of Sr^{90} in humans. It was found that single parenteral doses of 10 μc do not effect life span, tumor development, or leukocyte count in humans. Bone tissue in rats retain only 15 to 20% of the Sr^{90}, hence the permissible dose in human bones should be 1.5 to 2 μc. It was verified that the internationally established permissible maximum of Sr^{90} (1 μc) is experimentally sound and offers a sufficient safety factor. (R.V.J.)

9907 ON THE BEHAVIOR OF LONG-LIVED RADIOISOTOPES IN SHEEP ORGANISM DURING PROTRACTED PERORAL ADMINISTRATION. L. A. Buldakov. p.70-9 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Protracted oral administration of Ce^{144}, Cs^{137}, and Sr^{90} resulted in Ce^{144} absorption by intestines, 0.034%, bone tissue, 60%, and liver, 25%. The effective excretion period coincides with the half-life of the isotope; the absorption of Cs^{137} does not exceed 17.44% of that administered, with 13.2% deposited in the muscles, 75% is excreted in 9.25 days and the remaining 25% in 37.7 days. In intravenous injection the deposition of Sr^{90} in the skeleton is 26% and in the muscle 1.99%, while in oral administration it is 2.4 and 0.9% respectively. After single oral administrations of Sr^{90} the uptake by the intestines is about 10%. Excretion of 25% takes place in 23.5 days and 75% in 40 days. The accumulation of Sr^{90} in one-year and three-year-old sheep skeletons after 300 days is 4.5 and 2.66 μc, respectively. (R.V.J.)

9908 BIOLOGICAL EFFECTS OF LONG-LIVED RADIOISOTOPES IN CHRONIC UPTAKE BY SHEEP ORGANS. L. A. Buldakov. p.80-7 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Effects of chronic admistration of Sr^{90}, Cs^{137}, and Ce^{144} in fodder on blood cell changes in sheep and their offsprings are analyzed. The daily uptake of cesium (4 μc/day) produced no effects on blood cells, while 3.91 μc/day of Sr^{90} for 10 months produced leukopenia, reduced the numbers of lymophocytes and neutrophils, and affected the blood of progenies. Administration of 1.85 μc/day of Ce^{144} increased the color indicies and developed lymphopenia in adult sheep but had no effects on the blood of progenies. Daily doses of 2.8 to 100 μc of mixed isotopes produced hyperchronic anemia (2 months after inception of the experiment) and leukopenia with lymphopenia. The progenies suffered from strong lymphocytosis. (R.V.J.)

9909 MIGRATION OF RADIOACTIVE STRONTIUM IN PREGNANT COWS. N. I. Burov. p.88-94 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

The uptake, excretion, and transmission of Sr^{90} to the progenies were studied in cattle. Absorption of Sr^{90} by intestines of pregnant cows was identical to that of non-pregnant cows (6 to 12%). The content of Sr^{90} in milk depends directly on lactation. The exretion of Sr^{90} in urine is smaller in pregnant animals than in non-pregnant (13 to 17.58% in pregnant and 26% in non-pregnant). The deposition of Sr^{90} in the skeleton of the embryos during the 4th, 7th, and 9th months is 1.685, 5.182, and 13.3% respectively. (R.V.J.)

9910 THE INFLUENCE OF CALCIUM DIET IN LACTATING COWS ON THE EXCRETION OF RADIOACTIVE FISSION PRODUCTS IN MILK. B. N. Annenkov. p.95-100 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

The excretion of radioactive products with milk in chronic radioisotope uptake through fodder and the effects of excess of calcium in the diet on the excretion was investigated in 9 cows weighing 450 to 530 kg and producing 3000 to 4000 l of milk per lactation period. An excess of calcium does not reduce milk contamination. With high milk production the excretion of Sr^{90} reaches 2.74 to 3.20% of the uptake. (R.V.J.)

9911 TOXIC EFFECTS OF Sr^{90} ON ERYTHROCYTES IN RATS. Z. I. Kalmykova. p.101-10 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Experiments with 118 white mice weighing 150 to 250 g showed that single intraperitonial administration of 1000 μc of Sr^{90} produced changes in the size and osmotic resistance of erythrocytes, culminating within a week in spontaneous hemolysis followed by a drop in the number of erythrocytes within 2 weeks. A dose of 100 μc caused slight changes in the red blood, the changes becoming more pronounced with chronic doses. Administration of Sr^{90} induced toxic effects in the blood serum followed by hemolysis appearing simultaneously with the radical disturbances in erythrocytes. (R.V.J.)

9912 BEHAVIOR OF Ce^{144} IN INHALATION BY RATS. E. R. Lyuchanskii. p.111-18 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

The behavior of Ce^{144} hydrochloride (pH = 2) inhaled by rats at various times and in various amounts was investigated. It is shown that 48.7% of the Ce^{144} was retained, 19.4% being deposited in the lungs. Sixty-five days later the lungs contained 0.91% of the inhaled dose or 4.7% of that initial by retained. The Ce^{144} content of the lungs is higher than that of the liver or skeleton. The rate of resorption is highest 30 min after inhalation. The basic quantities of resorbed Ce^{144} are deposited in the skeleton and liver. During the observed 16 days, 0.4% of inhaled Ce^{144} was excreted in urine and 65% in the fecal matter. (R.V.J.)

9913 MINERAL METABOLISM AND NITROGEN CONTENT IN THE BONE TISSUE OF RATS DEPENDING ON THEIR AGE. N. I. Elkina. p.128-35 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

The deposition of Ca, P, Mg, Sr, and general N; the activity of alkali and acid phosphatae, and the intensity of

Ca^{45} and P^{32} inclusion in epiphyseal and diepiphyseal rat bone were studied for 630 days. Between the 30th and 630th days, Ca deposition increased 23% diepiphysis and 33% epiphysis. The N content dropped 33 to 46% respectively, and P increased between 30 and 270 days and decreased thereafter. The specific activity of Ca^{45} dropped 72% in both bone regions between the 30th and 630th days; P^{32} dropped 93% during the same period. The activity of the alkali and acid phosphatase dropped 75 and 87% respectively during the interval from 30 to 630 days. The most pronounced changes took place between the 30th to 270th day. Metabolic processes in bone tissue induced by plutonium were similar to the processes of natural aging. (R.V.J.)

9914 HISTOAUTORADIOGRAPHIC DATA ON PLUTONIUM DISTRIBUTION IN LIVER AND BONES. V. K. Lemberg, Z. M. Bukhtoyarova, and A. P. Nifatov. p.136-44 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Histoautoradiographic studies were made of Pu^{239} distribution in liver and bone tissues. Diffusive distribution appears in all liver tissues 6 to 12 hr following the administration. During the following 225 days the amount of Pu in liver cells steadily diminishes and deposits in Kupffer and microphage perivascular conjunctive tissue. Plutonium in bone does not diffuse readily, and on the third day a sharp increase of the level in bone marrow is observed. (R.V.J.)

9915 DYNAMICS OF MORPHOLOGICAL CHANGES INDUCED BY PLUTONIUM-239 IN LIVER OF RABBITS. A. P. Nifatov. p.145-54 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Administration of 2.1×10^{-2} and 4×10^{-3} μc/g doses of Pu^{239} induces cirrhosis in 77.5% of the animals within 3 to 6 months. Doses of 2×10^{-3} μc/g induce cirrhosis in 23% of the animals within 9 months. (R.V.J.)

9916 DYNAMICS OF THE BONE TISSUE CHANGES INDUCED BY Pu^{239} IN RABBITS. Z. M. Bukhtoyarova. p.155-63 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

The influence of incorporated Pu^{239} in rabbit bone tissue on growth and development was investigated. Acute and subacute doses (21.0, 14.0, and 7.0 μc/kg) induce destructive processes followed by bone marrow aplasia, while chronic doses (2.0 μc/kg) induce neoplasmic growth. (R.V.J.)

9917 HISTOPATHOLOGY IN RABBIT GONADS INDUCED BY INCORPORATED PLUTONIUM. N. A. Koshurnikova. p.164-73 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

The early stages of pathological processes are induced by direct radiation injury, while remote effects are the result of the general condition of the organism. The dynamics of injuries to spermatogenesis is of a phase character, the depressing phases are alternated with restorative phases in which spermatagonium is restored by undifferentiated sperm ductile cells. In ovaries restorative phases do not appear in chronic exposure from incorporated plutonium. (R.V.J.)

9918 REMOTE EFFECTS OF INTRAPERITONEAL INCORPORATION OF PLUTONIUM ACETATE. A. P. Nifatov. p.174-81 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

Intraperitoneal incorporation of plutonyl acetates or nitrates induce tumors, primarily osteosarcomas; the highest percentage being induced by 3.3×10^{-3} μc/g. The number of hematopoietic system tumors is higher with acetate than with nitrate. The optimum blastomogenic doses for plutonium acetate are 1.6×10^{-3} and 3.3×10^{-3} μc/g doses. (R.V.J.)

9919 POSSIBLE MEANS OF PLUTONIUM EXCRETION FROM ANIMAL ORGANISM. Yu. A. Belyaev. p.182-9 of "Biologicheskoe Deistvie Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov." Moscow, Gosatomizdat, 1961. (In Russian)

The efficiency of various measures in promoting Pu excretion from the gastrointestinal tract were analyzed and compared. It is shown that early administration of 100 mg/kg of diethylenetriaminopenta acetic acid (DTPA) reduces the amount of Pu in the skeleton by a factor of 5 and in the liver by factors of 8 to 11. (R.V.J.)

Radiation Sickness

9920 (ASD-TR-61-221) THE RADIOPROTECTIVE EFFECT OF MIXTURES OF AET AND SEROTONIN. E. G. Sander and Marilyn George (Aeronautical Systems Div. Aerospace Medical Lab., Wright-Patterson AFB, Ohio). June 1961. 10p. (AD-266336)

Experiments were conducted to determine the protection provided the erythropoietic system of rats against whole-body, gamma radiation by mixtures of AET (2-aminoethyl-isothiouronium bromide) and serotonin (5-hydroxytryptamine). The incorporation of Fe^{59} into newly formed red blood cells was used as the criterion of the radioprotection afforded. Two concentrations of AET plus serotonin (40 μM AET, 20 μM serotonin and 20 μM AET, 10 μM serotonin) offered initial protection against the depression of the erythropoietic rate associated with radiation exposure. The higher concentration of this mixture produced mortality due to the toxicity of the compounds. AET and serotonin mixtures did not alter the initial radiation-induced leucopenia. However, the protected rats had higher white blood cell counts 18 days after radiation exposure. Daily gains in body weight appeared somewhat greater in the rats injected with AET and serotonin than in the nonprotected, irradiated animals. (auth)

9921 (JPRS-12310) THE EFFECT OF IONIZING RADIATIONS ON VITAMINS AND THE RATIONAL VITAMIN THERAPY OF RADIATION SICKNESS. Translation of two Articles from the Book: "Ioniziruyushchie Radiatsii i Vitaminy" (Ionizing Radiations and Vitamins) Chapter III and Portion of Chapter V, Moscow, 1960. 24p.

Two papers are included which treat radiation effects on vitamins in complex systems and vitamin therapy of radiation sickness, respectively. Separate abstracts were prepared for both papers. (D.L.C.)

9922 (JPRS-12310(p.1-14)) THE EFFECT OF IONIZING RADIATIONS ON VITAMINS IN COMPLEX SYSTEMS. Translation of p.39-49, Chapter III from "Ioniziruyushchie Radiatsii i Vitaminy."

A review is presented on the effects of ionizing radiations on vitamins in complex in vitro systems such as food products. The problem of vitamin destruction in radiosterilization of foods is discussed. It is concluded that proteins, nucleic acids, and other high-molecular-weight compounds of the biosubstrate exert a strong protective effect on vitamins. (D.L.C.)

9923 (JPRS-12310(p.15-23)) THE PROBLEM OF RATIONAL VITAMIN THERAPY OF RADIATION SICKNESS.

Translation of p.119-25, Chapter V from "Ioniziruyushchie Radiatsii i Vitaminy."

Contradictions in data on the effects of vitamins on radiation sickness are discussed. The beneficial effect of vitamin therapy is partly due to relief of vitamin deficiency. The question of what vitamins and in what doses to administer in case of radiation sickness is discussed, and it is emphasized that vitamins are effective only when used in conjunction with other means of therapy, e.g., proper diet, blood transfusions, antibiotics, etc. (D.L.C.)

9924 POSTIRRADIATION TREATMENT OF LETHAL TOTAL BODY IRRADIATION BY CELL-FREE SPLEEN EXTRACTS. Friedrich Ellinger (Naval Medical Research Inst., Bethesda, Md.). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 547-54(Mar. 1962).

Post-irradiation treatment with homologous as well as heterologous cell-free spleen extracts in appropriate doses was found to reduce radiation mortality in guinea pigs. Treatment with cell-free spleen extracts restored spleen and bone marrow. Other advantages of the use of spleen extracts over marrow grafts are also given along with its advantages over chemicals. Spleen extract treatment can be started after irradiation (during the latent period) when most chemicals fail to reduce mortality. Treatment with cell-free spleen extracts is also free from unpleasant side and deleterious late effects. (P.C.H.)

9925 CERTAIN MECHANISMS UNDERLYING DISTURBED FUNCTION OF THE MYOCARDIUM IN ACUTE RADIATION SICKNESS. I. A. Pigalev, B. B. Moroz, and S. P. Grozdov. Med. Radiol., 6: No. 12, 29-36(Dec. 1961). (In Russian)

It was established that early changes in the ionic composition of the medium (increased intracellular/extracellular ratio and the loss of K) tend to enhance the excitability of the myocardium and, apparently, intensify the effect produced by the catecholamine on the heart. The nonuniform nature of lesions affecting the myocardium also serves as a contributive factor to the intensified action of pharmacological agents. A preliminary effect on the organism calling forth a stress-reaction tends to alter the character of cardiac disturbances developing after irradiation. (auth)

9926 RESEARCH INTO THE ADAPTATION OF BONE MARROW CELLS OF THE RED SERIES TRANSPLANTED IN ACUTE RADIATION SICKNESS. G. I. Kozinets and G. V. Sukyasyan (Central Order of Lenin Inst. of Hematology and Blood Transfusion, Ministry of Public Health, USSR). Med. Radiol., 6: No. 12, 36-40(Dec. 1961). (In Russian)

Labeled bone marrow, administered intravenously or intra-osseously to dogs, apes, and rats, matured until it reached its terminal stage. The evidence thereto was the appearance of activity in the erythrocytes of the recipients. Erythrocyte activity was recorded with scintillation counters and by autoradiography. (auth)

9927 THE USE OF POLYVINYL-ALCOHOL-GLUCOSE-CITRATE LEUKOCYTIC MASS IN LEUKOPENIA. S. N. Allaverdyan, E. S. Gazaryan and E. Kh. Sarkisyan (Eolyan Scientific-Research Inst. of Hematology and Blood Transfusion and Scientific Research Inst. of Roentgenology and Radiology, Armenian SSR). Med. Radiol., 6: No. 12, 40-5(Dec. 1961). (In Russian)

After detailed laboratory and experimental investigations, polyvinyl alcohol-glucose citrate leukocytic mass was used in the treatment of patients with malignant neoplasms after the development of leukopenia following radiation and chemotherapy. Observations demonstrated the effectiveness of the treatment in patients suffering from leukopenia of radiation and medicinal origin. The leukocytic mass is recommended for use in the complex of therapeutic measures in radiation treatment and chemotherapy of malignant neoformations attended by the development of leukopenia. However, special attention should be paid to the prevention of radiation and medicinal leukopenias occurring as the result of radium and chemotherapy. (auth)

9928 THE PROTECTIVE ACTION OF NATIVE AND PURIFIED CONCENTRATED SERUM OF IRRADIATED ANIMALS AGAINST RADIATION SICKNESS. A. T. Kravchenko and V. I. Fofanov. Med. Radiol., 6: No. 12, 46-50 (Dec. 1961). (In Russian)

The resistance of white rats to γ irradiation following preliminary immunization with blood serum proteins of previously irradiated animals, isolated from the serum in 50% ammonium sulfate saturation (globulin fraction), was studied. Introduction of these proteins to animals prior to irradiation augments their resistance. The albumin fraction has no such properties. (auth)

9929 THE PROTECTIVE PROPHYLACTIC ACTION OF CYANOCOBALAMIN IN WHOLE-BODY IRRADIATION. O. V. Bukharin. Med. Radiol., 6: No. 12, 72-4(Dec. 1961). (In Russian)

Whole-body exposure to 425 r depressed the absorptive function of reticulo-endothelial system and the bactericide function of the tissue, reduced the number of erythrocytes and leukocytes, and reduced peripheral blood hemoglobin. Prophylactic introduction of vitamin B_{12}, 5 γ/kg for 8 days, showed stimulating effects in the depressed absorptive functions and on the morphological blood composition. (R.V.J.)

9930 THE UTILIZATION OF ANTIHISTAMINIC PREPARATIONS IN THE TREATMENT OF EXPERIMENTAL ACUTE RADIATION SICKNESS. S. A. Davydova and E. N. Shcherbova. Med. Radiol., 6: No. 12, 74(Dec. 1961). (In Russian)

Studies of 365 white mice, 110 rats, and 23 dogs injected with dimerole and dinesine and irradiated with γ and x rays showed that the antihistamine preparations reduced the blood disturbances. (R.V.J.)

9931 REGULARITIES PERTAINING TO THE DISTRIBUTION AND EXCRETION OF CERTAIN MEDICINAL SUBSTANCES IN RADIATION SICKNESS. A. V. Smirnova. Med. Radiol., 6: No. 12, 75(Dec. 1961). (In Russian)

Disturbances in absorption, distribution, and excretion of various medicinal substances were studied in 180 to 200 g rats exposed to 500-r whole-body irradiation. The results showed different reactions to various medications. The penetration of sodium sulfacyl was faster in the blood and organs and excretion in the urine was very rapid. Penicillin penetration was slow during the first 15 min, after which it reached to high levels, and was retained longer; similarly, excretion was first slow then normal. The absorption of sodium salicylate was higher in irradiated animals. It was concluded that preparations of sodium salicylate and penicillin could be used to reduce radiation increased penetrability of structural tissue. (R.V.J.)

9932 METAL ION REDOX SYSTEMS AS RADIATION PROTECTIVE AGENTS. J. A. V. Butler and A. B. Robins (Chester Beatty Research Inst., London). Nature, 193: 673-4(Feb. 17, 1962).

The primary action of ionizing radiation is to cause the emission of electrons from molecules. Molecules that have lost or gained electrons are often unstable radicals which may undergo changes in the interval between ioni-

zation and the subsequent neutralization. It follows that any added substance which assists the charges to neutralize each other will reduce the liability of the enzyme to undergo chemical changes which result in loss of enzymatic activity. Thus an experiment is discussed in which ferrous and ferric ions (ferrous and ferric sulfates) act as protective agents for solid trypsin and cysteine. The experiments show that these ions modify the radiosensitivity by offering sites which can act as either sources of electrons or positive holes and so facilitate the neutralization of the enzyme molecules which have lost or gained electrons. (N.W.R.)

CHEMISTRY

General and Miscellaneous

9933 (IS-331) HEAT CAPACITY AND MAGNETIC SUSCEPTIBILITY OF THULIUM ETHYLSULFATE. Bernard Clemence Gerstein and F. H. Spedding (Ames Lab., Ames, Iowa). Aug. 1960. Contract W-7405-eng-82. 161p.

The magnetic heat capacity and the single crystal magnetic susceptibilities of TmE.S. were measured in the range 12 to 300°K and 1.4 to 200°K, respectively. The magnetic heat capacity of LuE.S. is measured to evaluate the lattice contribution to TmE.S. Two maxima were observed in the magnetic heat capacity at 19 and 80°K. The magnetic heat capacity and susceptibilities were calculated using the crystalline field approximation and two different sets of crystalline field constants. In neither case was close agreement obtained between theory and experiment, although the calculated and experimental perpendicular susceptibilities were in agreement. It is not obvious whether the lack of good agreement between experiment and theory is a result of a poor choice of crystal field parameters, a complete failure of the crystal field approximation in this case, or a breakdown of the assumptions involved in calculating the term intervals and splittings for trivalent Tm. (auth)

9934 BILLIARD-BALL COLLISIONS IN THE REACTIONS OF HOT HYDROGEN ATOMS. ISOTOPE EFFECT ON HYDROGEN DISPLACEMENT IN METHANE. R. J. Cross, Jr. and R. Wolfgang (Yale Univ., New Haven). J. Chem. Phys., 35: 2002-7(Dec. 1961).

The nature of collisions leading to reactions of hydrogen atoms of high kinetic energy (in the form of recoil tritium) was investigated. Two extreme models were examined. One assumes very weak coupling by valence bonds in the molecule attacked, so that the reaction can be represented by a quasi-elastic atom-atom collision (billiard-ball model) and the other assumes strong valence bond coupling (epithermal model). Calculations on the billiard-ball (hard sphere) model of the reaction $T^* + CH_4 \rightarrow H + CH_3T$ leads to an estimate of its relative cross section as a function of energy. An isotope effect for reaction with CH_4 and with CD_4 is calculated and measured experimentally. Consideration of both the calculations and the experimental results indicate that the billiard-ball model is unimportant in the reactions of gas phase hot hydrogen (as recoil tritium), and that reactions occur nearly exclusively at less than 10-20 ev of kinetic energy by mechanisms involving strong bond coupling. The possible importance of the billiard-ball model in the reactions of other hot atoms is briefly discussed. (auth)

9935 POSITRONIUM FORMATION IN THE HALOGEN DERIVATIVES OF BENZENE. C. R. Hatcher (Univ. of California, Livermore). J. Chem. Phys., 35: 2266-7(Dec. 1961). (BNL-6520)

Evidence is given to show that, for annihilation in the halogen derivatives of benzene, the intensity I_2 of the long component can be explained on the basis of the Ore model of positronium formation where the upper bound of the Ore gap is equal to the dissociation potential of the carbon–halogen bond. It was concluded that, for the compounds studied, positronium formation can be explained on the basis of energy considerations, and that molecular dissociation is the major competing process. (P.C.H.)

9936 THE CALCULATIONS OF STABILITY CONSTANTS USING A HIGH SPEED DIGITAL COMPUTER. J. A. Chopoorian, G. R. Choppin, H. C. Griffith, and R. Chandler (Florida State Univ., Tallahassee). J. Inorg. & Nuclear Chem., 21: 21-4(Dec. 1961). (In English)

A least squares technique for calculating stability constants from potentiometric titration data is described for use with a high speed digital computer such as the I.B.M. 650. (auth)

9937 THE MASS SPECTRUM OF TRIMETHYLBOROXINE. W. J. Lehmann, C. O. Wilson, Jr., and I. Shapiro (Hughes Tool Co., Culver City, Calif. and Olin Mathieson Chemical Corp., Pasadena, Calif.). J. Inorg. & Nuclear Chem., 21: 25-32(Dec. 1961). (In English)

Comparison of the mass spectra of isotopically normal and B^{10}-enriched trimethylboroxines makes possible the identification of the various fragments. The spectra furnish independent substantiation of the molecular weight and structure of $(CH_3)_3B_3O_3$—a ring with considerable aromatic character. The B^{10}/B^{11} isotopic abundance ratio determined from the principal-peak region is 0.251. Theoretical considerations involving molecular vibrations are introduced to show that there are minimum isotopic effects on fragmentation, and consequently on the calculated abundance ratio, when bond rupture is produced by vibration of light atoms or groups against heavy boron-containing groups. (auth)

9938 HETEROGENEOUS EQUILIBRIA IN THE SYSTEM WATER–NITRIC ACID–DI-n-BUTYL PHOSPHATE. A. S. Kertes, A. Beck, and Y. Habousha (Hebrew Univ., Jerusalem). J. Inorg. & Nuclear Chem., 21: 108-23(Dec. 1961). (In English)

Di-n-butyl phosphate solutions of nitric acid were investigated to determine the stoichiometry and stability of the molecular-association compounds formed in the heterogeneous reaction between these two components. From the variation of the physical-chemical properties of the organic layers, and from the variation of the distribution of HNO_3, the empirical formulas of the extracted species were found to be close to $(DBP \cdot H_2O)_2 \cdot HNO_3$, $DBP \cdot H_2O \cdot HNO_3$ and $DBP \cdot H_2O \cdot (HNO_3)_2$. Electrical conductivity and viscosity measurements showed that HNO_3 in undiluted DBP is substantially ionized when in equilibrium with dilute aqueous solutions of the acid. The effect of adding an inert diluent to the organic phase was studied. The solubility of DBP in water and aqueous nitric acid solutions was measured for a range of DBP concentrations. With a reasonable assumption as to the extraction mechanism involved, an attempt was made to calculate the formation constants of the individual species. (auth)

9939 PREPARATION OF FLUOROBORAZINES. R. K. Pearson and J. W. Frazer (Univ. of California, Livermore). J. Inorg. & Nuclear Chem., 21: 188-9(Dec. 1961). (UCRL-6433). (In English)

Diborane was found to react with tetrafluorohydrazine at 140 to 160°C to yield a mixture of fluoroborazines ($B_3N_3H_nF_{6-n}$) together with BF_3, B_2H_3, H_2, N_2, and BF_3NH_3. Yields of fluoroborazines varied from 5 to 20%. Preliminary separation of the reaction products was accomplished by high vacuum fractional condensation techniques using traps at −63, −78, and −196°C. The mass spectrum of the $B_3N_3H_5F$ fraction was found to be complex. The highest series of peaks began at a m/e of 92 and ended abruptly at 99. The mass spectrum of the $B_3N_3H_4F_2$ fraction was similar to that of $B_3N_3H_5F$ with the exception of a series of

peaks beginning at a m/e of 113 and ending abruptly at 117. It is believed that both fractions are mixtures of isomers. The hazards in working with the synthesis are also discussed. (P.C.H.)

Analytical Procedures

Refer also to abstract 9750

9940 (BM-IC-8039) SPECTROCHEMICAL ANALYSIS OF HIGH-PURITY METALS: A REVIEW AND BIBLIOGRAPHY OF RECENT LITERATURE. Maurice J. Peterson (Bureau of Mines, College Park, Md.). Jan. 1960. 52p.

The applications of optical spectrochemical analytic methods for determining trace impurities in metals are reviewed. A bibliography of 174 references, most with appended abstracts, is included which is arranged according to the base metal concerned. (D.L.C.)

9941 (CEA-1999) DOSAGE DE TRACES D'HALOGENES PAR LA METHODE SPECTROGRAPHIQUE. (Spectrographic Determination of Traces of Halogens). Jeanne Melamed (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 53p.

A hollow cathode source was employed for determining traces of halogens (fluorine and chlorine) in the uranium oxide U_3O_8 qualitatively. Detection of at least 40 ppm of fluorine, as alkali fluoride, and 125 ppm of chlorine, is possible. (auth)

9942 (CRDC-732) A LABORATORY PROCEDURE FOR THE DETERMINATION OF OXYGEN IN PRESSURIZED WATER LOOPS BY THE VACUUM WINKLER METHOD. Iain H. Crocker and R. J. Williams (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1962. 16p. (AECL-1439).

The method is an adaptation of ASTM procedure D888-49T non-reference Method A. Vacuum deaeration of the reagents and vacuum sampling of the loop are the key modifications of this procedure. The method has an accuracy of 0.007 ppm and precision of 0.004 ppm. (J.R.D.)

9943 (EURAEC-109) NUCLEAR APPLICATION OF TRANSIENT ELECTRO-ANALYTICAL METHODS. Quarterly Report No. 1, 1960. (Brussels. Université). 1960. Work performed under United States-Euratom Joint Research and Development Program. Contract 018-60-7-RDB. 9p.

The design and construction of model equipment to be used for various electro-analytical applications in the field of nuclear chemistry are discussed. The electronic assembly substituted for the cathode ray oscillograph is based on the use of triggers connected with electronic chronometers which apply the principle of impulse counters. Circuits other than the control triggers, the chronometers, and their leads are of fairly standard design. A series of successive stages was devoted to the theoretical study of the complete diagram of a chronometric counting unit; the fabrication of a trial prototype; the examination of the prototype's operating characteristics and their improvement; the series production of 12 units; the fabrication of an assembly rack provided with a ventilation system; and the design, fabrication, and finalizing of the entire current supply installation to be used for this electronic assembly. Tests are underway on the entire chronometric assembly. (M.C.G.)

9944 (HW-63261) MEASUREMENT OF TRACE QUANTITIES OF ZINC SULFIDE BY COUNTING PHOSPHORESCENCE EMISSION. R. W. Perkins and J. D. Ludwick (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 23, 1959. Contract AT(45-1)-1350. 22p.

An analytical procedure based on electronically counting the individual phosphorescence photons following light-excitation was developed for the measurement of scintillation-grade zinc sulfide particles on molecular air filters. The zinc sulfide was collected on these filters during meteorological studies of particle dispersion. The analytical procedure involves dissolving a zinc sulfide laden filter in an EtOH–EtAc solvent, exposing the sample to a fluorescent lamp, allowing the sample to "decay" (in the dark) for 30 seconds, then counting the phosphorescence photon emission for 30 seconds. The counting equipment requirements are similar to those commonly used for counting tritium. The conditions of excitation and measurement yielded about 2×10^4 counts per microgram of zinc sulfide or a sensitivity of about 10^{-9} grams. A sensitivity improvement of one to two orders of magnitude could be obtained by minor procedural changes. The precision of the zinc sulfide measurements on clean and dirty filters is about ±3 and ±6% standard deviation. Corrections for loss in counting efficiency on dirty filters are made from optical density measurements with a colorimeter. (auth)

9945 (HW-71435) A DEMONSTRATION OF DETERMINING PLUTONIUM IN URANIUM BY CONTROLLED POTENTIAL COULOMETRY. W. L. Delvin and L. R. Duncan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 24, 1961. Contract AT(45-1)-1350. 8p.

The reliability of controlled potential coulometry for determining plutonium in uranium is demonstrated. Two unirradiated uranium–plutonium fuel elements were used for the analysis. The results are presented in tabular form. For the two fuel elements the ratio of % Pu found to % Pu make-up was 0.996 and 1.007. (auth)

9946 (HW-72608) AN EVALUATION OF STANDARDIZATION MODES FOR CERIC SULFATE USING AN IMPROVED MACRO BURETTE. Patricia F. Raney (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 13, 1961. Contract AT(45-1)-1350. 9p.

Standardization techniques for ceric sulfate solutions with low bias and high precision were examined. The arsenious oxide potentiometric end point system was found to be best because the method was the most precise of those tried, and it was simple and quick. (J.R.D.)

9947 (PG-Report-282) ANALYTICAL METHOD FOR THE DETERMINATION OF RADIO-CAESIUM AND RADIO-STRONTIUM IN PLANT SOLUTIONS (ANION EXCHANGE RESIN SEPARATION). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 9p.

An analytical method is described for the determination of radioisotopes of Sr and Ce in radioactive solutions. The sample solution, together with added carriers, is passed down an anion exchange column in the hydroxide form. Sr is precipitated from the column effluent as carbonate, which is dissolved and the Sr precipitated as oxalate. The activity of the oxalate is measured. Cesium is precipitated from the supernatant liquid from the Sr separation in the form of perchlorate, and its activity measured. Procedures of an alternate method for Cs only are included. (C.H.)

9948 (PG-Report-283) METHOD OF SAMPLING OF LIQUID CARBON DIOXIDE BEFORE ANALYSIS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 5p.

The liquid CO_2 is vaporized in passage through a heated copper coil, the gaseous sample being drawn off at the coil outlet. (J.R.D.)

9949 (PG-Report-287) ANALYTICAL METHOD FOR THE DETERMINATION OF CARBON-14 IN REACTOR COOLANT GAS. (United Kingdom Atomic Energy Authority. Production Group. Windscale, Sellafield, England). 1962. 6p.

The gas sample is absorbed by KOH then CO_2 is regenerated and absorbed by BaOH solution. The CO is converted to CO_2 and in turn absorbed by BaOH. Precipitating barium carbonates are gelled with a scintillant and the C^{14} measured with a counter. (J.R.D.)

9950 (PG-Report-290) ANALYTICAL METHOD FOR THE ASSAY OF PLUTONIUM METAL (DIFFERENTIAL SPECTROPHOTOMETRY). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 4p.

A procedure is presented for the assay of routine production Pu metal billets by differential spectrophotometry. A solution of the metal in HCl is prepared and its relative absorbancy measured at 565 mμ against that of a Pu reference standard. (C.H.)

9951 (PG-Report-297) ANALYTICAL METHOD FOR THE DETERMINATION OF PLUTONIUM IN THE PRODUCT FROM THE PLUTONIUM PURIFICATION PLANT (DIFFERENTIAL SPECTROPHOTOMETRY). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 3p.

The Pu in the sample is reduced to the trivalent state with hydroxylamine hydrochloride. The absorbancy is compared with that of a Pu standard at 565 mμ. The precision (three times the standard deviation) is ±0.28% at the 5 mg Pu/ml level. (J.R.D.)

9952 (PG-Report-299) ANALYTICAL METHODS FOR THE INSPECTION OF PURE DRIED VACUUM SALT (SODIUM CHLORIDE). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 5p.

The inspection includes a volumetric acidity or alkalinity determination, gravimetric determination of volatile matter, and a visual assay for color and appearance. (J.R.D.)

9953 (PG-Report-300) ANALYTICAL METHOD FOR THE DETERMINATION OF PLUTONIUM IN THE FEED AND PRODUCT SOLUTIONS OF THE PLUTONIUM PURIFICATION PLANT (DIRECT RADIOMETRIC). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 4p.

A sample is evaporated on a flat stainless-steel counting tray and the α activity measured with a proportional counter. The precision is three times the standard deviation = 5.2%. (J.R.D.)

9954 (TID-14811) DEVELOPMENT OF KRYPTON-85 CLATHRATE ANALYTICAL TECHNIQUES TO MEASURE OXIDATION-REDUCTION PRODUCTS IN THE LIQUID STATE. Quarterly Technical Status Report No. 2, October 1, 1961 to December 31, 1961. George J. Rotariu and Elizabeth L. Hoskins (Booz-Allen Applied Research, Inc., Glenview, Ill.). Jan. 23, 1962. Contract AT(11-1)-1061. 54p.

The system of SO_2, $NaClO_2$, hydroquinone: SO_2 in benzene media was investigated further. This reaction is useful for detecting trace amounts of SO_2(g). The rate of the reaction is strongly dependent upon the $NaClO_2$/HQ: SO_2 weight ratio; below a ratio of about 3:1 the reaction is slow, while above a ratio of about 5:1, it is rapid. At a ratio of 20:1, the reaction is most vigorous, almost violent. This reaction produces an unusually high heat of reaction. Further work was done in preparing hydroquinone: SO_2 clathrate of high SO_2 content at atmospheric pressure. The aqueous-cooling technique is modified by a reheating procedure with constant agitation to yield a granular crystalline product in a few hours. The basic system which seems to be most promising for determining ferric ion contains, minimally: TTA in trifluorotoluene. The TTA extracts the ferric ion to form a complex, and an objective is to bring about a reaction between the ferric ion with the clathrate suspended in the trifluorotoluene with release of SO_2 proportionate to amount of ferric ion. A very specific fast reaction for nitrate ion was developed. Addition of nitrate to a mixture of hydroquinone plus HCl gas in trifluorotoluene yields gas bubbles (hydrogen gas) in proportion to the amount of nitrate used. The reaction proceeds at room temperature and is much faster at 45°C. The chelation chemistry for ferric-ion-TTA was reviewed and developed further. The distribution coefficient, D, ratio of ferric ion in trifluorotoluene to that in water, was measured for pH's of 1 and 2. A plot of log D vs. log (H^+) yields results in line with the theory. The value of D increases from about 0.1–0.2 at a pH of 1.0 to a value of 1.01 at a pH of 2. For very acid solution, D has a value of 5.8. The basic components of the nuclear measuring instrument to be used, a Nuclear-Chicago Model 6000, Dynacon Electrometer, were calibrated. The ion-chamber is in process of being calibrated; it will be used to measure the Kr-85 released from the clathrate-metal ion reaction being developed. (auth)

9955 (UCRL-Trans-774(L)) DETERMINATION OF OXYGEN IN ALUMINUM BY MELTING IN VACUUM. Luboš Kopa. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Hutnicke listy, 14: 322-4(1959). 13p. (Includes original, 2p.).

For determining oxygen in aluminum, the vacuum extraction method described by Sloman was investigated. Some of the disadvantages of this method were successfully removed by substituting the steel bath by a copper bath at a working temperature of 1550°C. The method was confirmed by determining the oxygen in aluminum samples to which known amounts of aluminum oxide were added. (auth)

9956 THE USE OF CHELATOCHROME INDICATORS IN PRECIPITATION TITRATIONS. PART V. Richard Pueschel (Universität, Graz, Austria). Chemist Analyst, 50: 58-62(June 1961).

Some salient information on the use of chelatochrome indicators in precipitation titrations is summarized for various metal ions. The material presented includes the common or dye name assigned the indicator, its systematic chemical name, and, where existing, the color index numbers and dye designations, and the F number of the Schultz-Lehmann dye tables. The table presented also lists all anions and cations determined by precipitation titrations employing the indicator in question. Special emphasis is placed on the chelatochrome indicators used in titrating barium, bismuth, cadmium, calcium, and higher alkaline earths, lead, mercury, magnesium, silver, thorium, and zinc. (N.W.R.)

9957 THE APPLICATION OF RADIOCHEMICAL ANALYTICAL METHODS TO THE DETERMINATION OF ZINC AND CALCIUM TRACES IN GALLIUM. Pierre Lerch and Leo Kreienbuehl (Universität, Bern). Chimia (Switz.), 15: 519-22(Nov. 15, 1961). (In German)

The method of thermal neutron activation analysis was utilized for the determination of calcium and zinc traces in metallic gallium. This method allows amounts of calcium

as low as one ppm to be measured by counting the calcium-45 β activity after chemical separation. The method could not be used for zinc traces, as a (n,p) nuclear reaction appeared as a result of the fast neutrons. The isotopic dilution method was found successful for zinc traces in metallic gallium. A sensitivity of 0.01 ppm was reached by counting the zinc-65γ activity in a scintillation spectrometer. (auth)

9958 RAPID METHOD FOR EVALUATION OF THE QUANTITIES OF Sr^{90} AND Y^{90} PRESENT IN A SOURCE IN WHICH THE TWO RADIOELEMENTS ARE NOT NECESSARILY IN RADIOACTIVE EQUILIBRIUM. Jean Bourrier, Pierre Bovard, and André Grauby (Institut du Génie Chimique, Toulouse). Compt. rend., 254: 462-7(Jan. 15, 1962). (In French)

A method is described for evaluating the concentrations of Sr^{90} and Y^{90}, based on the differences in their β energies. (tr-auth)

9959 A NEW PROCEDURE FOR PLUTONIUM URINALYSIS. S. Marshall Sanders, Jr. and Sarah C. Leidt. Health Phys., 6: 189-97(Oct. 1961).

A simple method of urinalysis, sensitive enough to detect 0.007 dis/min plutonium in 250 ml of urine, is described. In this method, anion exchange is used to separate plutonium from other inorganic ions remaining after evaporation and oxidation of the urine. The quantity of plutonium is then determined by counting α tracks in an autoradiograph of the metal disk upon which the plutonium has been electrodeposited. (auth)

9960 ELECTROPHORETIC ION FOCUSING. X. THE ANALYSIS OF RARE EARTH MIXTURES. Walter Friedli and Ernst Schumacher (Universität, Zurich). Helv. Chim. Acta, 44: 1829-56(1961). (In German)

The method of electrophoretic ion focussing (EFI) (focussing ion exchange) was applied to an analysis of rare earth mixtures. Using two systems of pH-pL gradients, the groups La–Tb and Eu–Lu were separated in 5 min. The identification, purity control, and quantitative determination of the lines in the EFI spectrum are effected by radioactivation and several radiochemical measurements: radiogram, autoradiogram, isotope dilution, β absorption, γ spectrum, and decay curves. The experimental technique is described in detail and a list of observed distortions of EFI-lines and other experimental failings together with their causes and remedies is included. The interpretation of the observed behavior of rare earths on separation by EFI by known complex chemical facts leads to the assumption of a protonated bicomplex with nitrilo-triacetic acid. (auth)

9961 FRACTIONATION REACTION FOR Be IONS. T. A. Soboleva (Kirov Ural Polytechnic Inst., USSR). Izvest. Vysshikh Ucheb. Zavedenii, Khim. i Khim. Tekhnol., 4: 364-5(1961). (In Russian)

A fractionation reaction using beryllon, with preliminary separation by caustic soda, is used for determining beryllium in mixtures composed of ordinary cations and UO_2^{2+}, Th^{4+}, Li^{+}, TiO^{2+}, ZrO^{2+}, and Ce^{3+}. The method is capable of determining a minimum beryllium content of 2.2γ/ml in mixed cations. (R.V.J.)

9962 NEW MASS SPECTROMETER SOLID SOURCE ARRANGEMENT FOR THE SIMULTANEOUS ANALYSIS OF TWO SAMPLES. H. Patterson and H. W. Wilson (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Sci. Instr., 39: 84-5(Feb. 1962).

The filaments of the usual triple filament assembly used in thermal ionization solid source mass spectrometers were rearranged to permit the analyses of two separate samples, on the same filament bead. One of these samples may be a standard. Smaller isotopic abundance differences can be detected using this new arrangement which confers on a solid source machine some of the advantages of a dual inlet gas machine. It also appears to have a somewhat higher efficiency for the production of ions. Experiments demonstrate the improvement in accuracy, and the absence of cross contamination provided certain precautions are observed. (auth)

9963 ACTIVATION ANALYSIS: 1962 FINDS IT IN A STATE OF RAPID GROWTH. Nucleonics, 20: No. 3, 54-9 (Mar. 1962).

The equipment and techniques developed as of 1962 are discussed. It is shown that activation analysis is being used more than ever due to the fact that the methods, equipment, and applications are becoming simpler and more sensitive. The new sources of neutrons and photons, new radiochemistry, new computer methods, and new methods of gamma and beta spectroscopy are briefly described. The application of the methods in tracing tracer elements, inorganics, criminal investigation, and reactor spectra measurements are also discussed. (N.W.R.)

9964 ACTIVATION ANALYSIS: NEW GENERATORS AND TECHNIQUES MAKE IT ROUTINE. W. Wayne Meinke and Ronald W. Shideler (Univ. of Michigan, Ann Arbor). Nucleonics, 20: No. 3, 60-5(Mar. 1962).

An easy-to-operate, inexpensive neutron generator that gives thermal fluxes of 2×10^8 n/cm^2/sec is described along with the techniques for routine activation analysis. The generator consists of three separate units: the accelerator with its vacuum system, the high-voltage power supply, and the control console. Particular emphasis is placed on the operation, shielding, design, preliminary adjustments, beam behavior, target life, and neutron output and flux. (N.W.R.)

9965 THE PREPARATION OF STANDARD SAMPLES FOR THE SPECTRAL ANALYTICAL DETERMINATION OF SMALL BORON CONCENTRATIONS IN REACTOR GRAPHITE. E. Golling (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Nukleonik, 3: 233-6(Nov. 1961). (In German)

The ashing of reactor graphite in the presence of a trace carrier and the chemical composition of the residue are reported. A method for the preparation of suitable standard samples is given. It is shown that in the standard sample the basic material and the boron admixture must be the same compounds as in the ash (the other ash fractions can be ignored). If these conditions are not fulfilled, a systematic error occurs which can show boron concentrations higher by a factor of 2 to 3. (tr-auth)

9966 GRAVIMETRIC DETERMINATION OF URANIUM AND THORIUM WITH 1-HYDROXY-XANTHONE. Brahm Dev and B. D. Jain (Univ. of Delhi). Proc. Indian Acad. Sci., Sec. A, 54: 341-4(Dec. 1961). (In English)

It was found that 1-hydroxy-xanthone can be used for the gravimetric determination of uranium and thorium alone or in the presence of large amounts of cerium(III) and lanthanum. The presence of cerium(IV) ions, even in minute quantities, interferes with the determinations, and if present, have to be reduced to the cerous state. (P.C.H.)

9967 ON THE X RAY FLUORESCENCE ANALYSIS OF ORES. V. P. Bykov and I. V. Sorokin (All-Union Inst. of Mineral Resources, [USSR]). Zavodskaya Lab., 27: 1371-4(1961). (In Russian)

Recording x-ray spectra with a scintillation pulse analyzer increased the sensitivity of the analyses for Zr,

Y, Nb, Mo, Sr, and Ge in concentrations above 0.002% to a maximum of 0.0001%. The "thin layer" method was used in combination with rarefaction. (tr-auth)

9968 ANALYTICAL CHEMISTRY. VOLUME 2. Carl E. Crouthamel, ed. Progress in Nuclear Energy. Series IX. New York, Pergamon Press, 1961. 405p. $15.00.

Separate abstracts were prepared for each of the 8 chapters contained. Discussion is given on some less familiar topics, because they show promise of having a marked influence on the future of analytical methods. For more familiar topics, a critical review is given of more recent advances. Separate author and subject indexes are included. (P.C.H.)

9969 RECENT ADVANCES IN COUNTING TECHNIQUES. Christopher Gatrousis, Robert Heinrich, and Carl E. Crouthamel (Argonne National Lab., Ill.). Progr. in Nuclear Energy, Ser. IX, 2: 1-79(1961).

Discussion is given on the role x-ray proportional counters have played in extending and simplifying conventional methods of chemical analysis. Particular attention is given to the fundamental processes that form the basis of proportional counting. Counter designs and methods of construction include a description of counters that were built and operated successfully during the past 2 years. A number of specific applications are also discussed in order to demonstrate the capabilities and versatility of the devices. 155 references are included. (P.C.H.)

9970 MAGNETIC RESONANCE SPECTROSCOPY APPLICATIONS OF ELECTRON SPIN RESONANCE SPECTROSCOPY TO ORGANIC AND INORGANIC CHEMISTRY. Herbert A. Elion and Louis Shapiro (Elion Instruments, Inc., Bristol, Penna.). Progr. in Nuclear Energy, Ser. IX, 2: 80-156(1961).

An introduction is given on electron paramagnetic resonance and its applications to organic and inorganic chemistry. Mention is made of the scope of the field, and various terms which have been used to define its area of operation are classified. The paramagnetic phenomena are considered to fall into two main categories: those resulting primarily from nuclear behavior and those having an electronic origin. In the first case, concern is primarily with energy transitions based on the spin of the nucleus and its associated magnetic moment. Absorption of energy is then interpreted as transitions between discrete energy levels. Deductions are made about the nature of the nuclei, basic lattice structure, electronic structure of specific molecules, effect of electronic and lattice environments on Larmor precession, energy couplings involving nuclear spin, orbits and spins of nearby particles, and applicable relaxation times. Special attention is also given to paramagnetic materials. 105 references are included. (P.C.H.)

9971 RECENT ADVANCES IN THE SEPARATION AND ANALYSIS OF THE TRANSURANIUM ELEMENTS. Darleane C. Hoffman (Los Alamos Scientific Lab., N. Mex.) Progr. in Nuclear Energy, Ser. IX, 2: 157-200(1961).

Discussion is given on various methods such as precipitation, solvent extraction, pyrometallurgy and volatilization, ion exchange, and recoil separations for separating transuranium elements. Special attention is given to the separation of neptunium and plutonium. Analytical methods discussed are gravimetric, volumetric, electrometric, spectrophotometric, x-ray, mass spectrometric, and radiochemical. 191 references are included. (P.C.H.)

9972 APPLICATIONS OF LIQUID-LIQUID EXTRACTION IN INORGANIC SEPARATIONS. D. F. Peppard (Argonne National Lab., Ill.). Progr. in Nuclear Energy, Ser. IX, 2: 201-23(1961).

Applications of separation phenomena uniquely associated with analytical nuclear chemical problems are discussed, along with an attempted explanation of these phenomena and projected extensions of the techniques discussed. The majority of the extraction data quoted pertain to radioactive, tracer-level solutes. Extraction stoichiometry is considered in some detail. It is concluded that the possible applications of liquid-liquid extraction techniques to the solution of analytical problems with nuclear aspects appear so promising that wide liberties were taken with the interpretation of the title. 83 references are included. (P.C.H.)

9973 FLAME PHOTOMETRY AND ATOMIC ABSORPTION SPECTROSCOPY. J. W. Robinson (Esso Standard, Baton Rouge, La.). Progr. in Nuclear Energy, Ser. IX, 2: 224-56(1961).

Results of a survey made of recent advances in the fields of high-temperature flame photometry (oxycyanogen flames) and the allied field of atomic absorption spectroscopy are given. It is felt that both these fields are potentially superior to conventional flame photometry, particularly with regard to sensitivity and freedom from interference. Limits of detection of various elements by conventional flame photometry, high-temperature flame photometry, and atomic absorption spectroscopy are tabulated. Interferences and problems associated with the analysis of metals more commonly determined by flame photometry and atomic absorption spectroscopy are outlined. Photographs of conventional commercial equipment, which indicate the wide variety of equipment available for research or routine applications of this sort, are given. (P.C.H.)

9974 RECENT ADVANCES IN ULTRAVIOLET, VISIBLE AND INFRARED ABSORPTION SPECTROMETRY. James C. White (Oak Ridge National Lab., Tenn.). Progr. in Nuclear Energy, Ser. IX, 2: 257-312(1961).

Coverage on the advances of ultraviolet, visible, and infrared absorption spectrometry is limited to a status and summary report of spectrophotometric discoveries of the past decade, 1950 to 1960, for the determination of certain elements of particular concern in nuclear research and technology. Elements discussed are U, Th, Zr, Tc, and the transuranium actinide elements, Np, Pu, and Am. No attempt was made to be comprehensive, but rather the intent is to present the status of methods at the present time. With respect to infrared spectrometry, emphasis is placed on the features of the technique that are of concern to analytical chemists working in the nuclear field. Extensive treatment is given to the pressed-pellet technique and to the application of absorption spectrometry to molten salts. 183 references are included. (P.C.H.)

9975 β-PARTICLE INTERACTIONS WITH MATTER; BACKSCATTERING AND EXCITATION OF CHARACTERISTIC X-RAYS. Ralph H. Mueller (Los Alamos Scientific Lab., N. Mex.). Progr. in Nuclear Energy, Ser. IX, 2: 313-37(1961).

Discussion is given on uses of radioactive isotopes, such as the absorption or backscattering of β particles, the production of bremsstrahlung and characteristic x rays by bombarding suitable targets with β particles, and other related phenomena. Analytical applications of β backscattering and β excited x rays are also given. 62 references are included. (P.C.H.)

9976 ION-EXCHANGE CHROMATOGRAPHY. J. E. Salmon (Battersea Coll. of Tech., London). Progr. in Nuclear Energy, Ser. IX, 2: 338-79(1961).

Discussion is given on column chromatography and ion exchange paper chromatography, including elution and exchange materials, and on possible developments and general conclusions for each type. A survey is given of developments in the field over the last 2 or 3 years, and likely developments are assessed. 180 references are included. (P.C.H.)

General Inorganic and Physical Chemistry

9977 (NP-11388) MATRIX ISOLATION OF HIGH TEMPERATURE VAPORS: BORIC OXIDE AND CARBON. Technical Report No. C-12. W. Weltner, Jr. and J. R. W. Warn (Union Carbide Corp. Research Inst., Tarrytown, N. Y.). Jan. 1962. Contract DA-30-069-ORD-2787. 52p.

The matrix isolation technique was extended to allow molecules which are in equilibrium with solids at high temperatures to be trapped and studied at low temperatures. A beam of the hot vapor issuing from a Knudsen cell or a heated surface is premixed with a large excess of argon or xenon just prior to condensation at 20°K. The method was applied to boric oxide vapor which was vaporized from the liquid at 1400°K. The infrared absorption spectrum of the B_2O_3 molecule in a solid inert gas matrix was measured between 280 and 3600 cm^{-1} and compared with the known vapor emission spectrum. Several new bands were found near 500 cm^{-1} which led to a considerable alteration in the vibrational assignment and the thermodynamic properties of the gaseous molecule. The infrared spectrum of B_2O_2 (produced by heating boron plus boric oxide) isolated in a matrix yielded one absorption band which agreed with the emission spectrum. A general program is described which was written for the IBM 7090 in order to permit the calculation of molecular force constants from assigned fundamental vibrational frequencies. With this program, an extensive normal coordinate treatment of B_2O_3 was made utilizing the observed spectra of B^{10} and B^{11} substituted molecules. The general applicability of the experimental technique was indicated by some preliminary work on the matrix isolation of carbon vapor formed at 2600°K. A strong infrared band appearing at 2040 cm^{-1} is assigned to the C_3 asymmetric stretching frequency. Warming the matrix slightly allowed diffusion of the C_3, C_2 and C species, and many new infrared bands appeared. It seems likely that information about the larger molecules in carbon vapor can be obtained in this way. (auth)

9978 (TID-14949) ORGANIC COOLANT RECLAMATION. Quarterly Progress Report No. 10, June 16, 1961 to September 15, 1961. D. A. Scola and J. S. Adams (Monsanto Research Corp. Boston Labs., Everett, Mass.). Sept. 1961. Contract AT(10-1)-1088. 13p.

Process studies of the solvent distribution process for coolant reclamation were centered on filtration and distillation tests. Based on tests carried out using a leaf filter, filtration rates of 35 to 50 gal/sq ft/hr may be obtained. The filter cake retained 40 to 50 wt % solvent, indicating a drying process to recover solvent must follow the filtration process. The micro-pilot plant was operated to test the 2-in. diameter distillation column packed with 3 × 2 in. wire cartridges. Twenty-one catalysts were tested for hydrocracking activity toward reclaimed high boiler. Copper, platinum, palladium, chromium, and molybdenum on acidic supports proved to be the best catalysts for hydrocracking reclaimed high boiler. Product yields varied from 33 to 88%; coke yields from 1.8 to 4.8%, and gas yields from 0.4 to 4.5%. Products from the best catalysts varied in physical appearance from brown oils to yellow oil-crystalline mixtures, a marked change from the solid, glass-like, dark-brown feed materials. The products had lower carbon-to-hydrogen ratios, lower molecular weights, lower viscosities, and higher decomposition temperatures than high boiler or reclaimed high boiler. Pyrolytic capsule fouling test data on product from the solvent distribution method (spent coolant-petroleum solvent) showed a 98% decrease in film formation. Spent coolant gave an average of 63.4 mg; reclaimed spent coolant gave an average of 1 mg. (auth)

9979 (TID-15017) HIGH TEMPERATURE CHEMISTRY — FUNDAMENTALS OF EFFUSION AND THERMODYNAMICS OF MATERIALS. Document A. Technical Progress Report, June 1, 1961 through January 31, 1962. Phillip G. Wahlbeck (Illinois Inst. of Tech., Chicago). Contract AT(11-1)-1029. 13p.

The problems involved in the use of the Knudsen method for vapor pressure determinations at high temperatures are discussed, and the status of experiments to study corrections and pressure effects in the Knudsen method is summarized. The linearity of a surface ionization detector is presently being investigated. Studies using effusion measurements will be made on the Ga–In system, metal–H systems, S_2, Se_2, and Te_2. Preliminary results are given for phase relations in the Y–H system. (D.L.C.)

9980 (TID-15018) THE SYNTHESIS OF ORGANO-METALLIC DERIVATIVES OF THE LANTHANIDE SERIES. Fourth Quarterly Progress Report, Period Ending February 15, 1962. ([Ethyl Corp., New York]). Contract AT(11-1)-999. 12p.

Dicyclopentadienyllanthanide chlorides were prepared of the series samarium, gadolinium, dysprosium, holmium, erbium, and ytterbium. With similar procedures the di(methylcyclopentadienyl)lanthanide chlorides of gadolinium, erbium, and ytterbium were also prepared. Attempts to prepare the same derivatives of the lower lanthanides, lanthanum, cerium, praseodymium, and neodymium were unsuccessful with a variety of experimental approaches. (auth)

9981 (TID-15019) THE EFFECTS OF POLYFUNCTIONAL ANIONS ON ELECTRON TRANSFER BETWEEN METAL IONS IN SOLUTIONS. Report of Progress. Carl H. Brubaker, Jr. (Michigan State Univ., East Lansing). [1962]. Contract AT(11-1)-1001. 8p.

Results are given for studies on the catalytic effects of maleic and tartaric acids on the oxidation of uranium(IV) by thallium(III). Studies were initiated on the anion catalysis of the uranium(III)-uranyl ion and iron(II)-iron(III) exchanges and on the cobalt(II)-cobalt(III) exchange in 12-tungstocobaltates. A method was developed for separating $[Co(W_2O_7)_6]^{9-}$ from $[Co(W_2O_7)_6]^{10-}$. (D.L.C.)

9982 (TID-15032) AN INVESTIGATION OF THE ISOTOPIC EXCHANGE OF ARSENIC ATOMS BETWEEN ARSENIC(III) AND ARSENIC(V) IN AQUEOUS HYDROCHLORIC ACID SOLUTIONS. Lewis L. Anderson (New Mexico. Univ., Albuquerque and Los Alamos Scientific Lab., N. Mex.). 1961. Contracts AT(11-1)-733 and [W-7405-Eng-36], Subcontract SC-5. 251p.

Thesis submitted to Univ. of New Mexico.

The kinetics of isotope exchange of arsenic atoms between As(III) and As(V) species in HCl, particularly 10.9[HCl were investigated at 29.6, 48.6, and 67.3°C. The rate of exchange was found to be dependent on the age of the As(V) solutions. A spectrophotometric investigation was initiated in order to provide additional evidence for the

existence of chemically nonequivalent species of As(V) in 10.9f HCl. No spectrophotometric evidence was found which would indicate that As(III) in 10.4 ± 0.5 or 6.94f HCl ages; the absorption bands did not change with time. Aging of As(V) in 10.4 ± 0.5f HCl was evidenced by the slow growth of the 2300 A absorption band. The isotope exchange between As(III) and As(V) was found to be measurable at 29.7°C. The exchange curves were found to consist of more than one exponential component. Elevation of the reaction temperature increased the rate of exchange. (M.C.G.)

9983 (AEC-tr-4450) JOURNAL OF INORGANIC CHEMISTRY. Translated from Zhur. Neorg. Khim., 3. No. 2, 241-551(1958). 436p. (PST-Cat.-372).

A cover-to-cover translation is presented. (M.C.G.)

9984 (AEC-tr-4453) JOURNAL OF INORGANIC CHEMISTRY. Translated from Zhur. Neorg. Khim., 3: No. 5, 1065-1269(1958). 302p. (PST-Cat.-375).

A cover-to-cover translation is presented. (M.C.G.)

9985 (AEC-tr-4455) JOURNAL OF INORGANIC CHEMISTRY. Translated from Zhur. Neorg. Khim., 3: No. 7, 1473-1717(1958). 351p. (PST-Cat.-377).

A cover-to-cover translation is presented. (M.C.G.)

9986 (AEC-tr-5017) CALCULATION OF VELOCITY CONSTANTS FROM EXPERIMENTAL DATA. J. A. Christiansen. Translated for Oak Ridge National Lab., Tenn. from Z. physik. Chem. (Leipzig), 189A: 126-30 (1941). 9p.

The calculation of velocity constants from an experiment with numerous individual readings is discussed. It was assumed that the significance attributed to individual measurements should be such that the minimum sum of the squares of the experimental error will coincide with the sum of the squares of errors in the reading of the degree of conversion. The mean velocity constant K was calculated from the individual values $K : K\Sigma G = \Sigma GK$. G-tables for the two simplest cases (reactions of the first and second order) are given from which other cases can be easily calculated. (auth)

9987 (UCRL-Trans-782) RATES OF CHEMICAL REACTIONS IN TURBULENT FLOWS. [PART] II. A. S. Predvoditelev. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 1, 14-21(1961). 23p. (Includes original, 8p.).

Development of a formula is described for determining the rate of chemical reactions in axially symmetric turbulent flow. Theoretical results are compared with data obtained by combustion of methane in burners with cylindrical nozzles and are found to agree. (J.R.D.)

9988 STUDIES ON THE HYDROLYSIS OF METAL IONS. 37. APPLICATION OF THE SELF-MEDIUM METHOD TO THE HYDROLYSIS OF BERYLLIUM PERCHLORATE. Birgitta Carell and Åke Olin (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 15: 1875-84(1961). (In English)

The hydrolysis of beryllium perchlorate was studied in the concentration range B = 0.04 – 1 M by measurements of log h at 25°C. A set of complexes at low beryllium concentrations, namely Be_2OH^{3+} and $Be_3(OH)_3^{3+}$, explain the data. $3\ Be^{2+} + 3\ H_2O \rightleftharpoons Be_3(OH)_3^{3+} + 3\ H^+$; $\log\beta_{3,3} = -8.66 \pm 0.03$ (B = 0.04 to 1 M) and $2\ Be^{2+} + H_2O \rightleftharpoons Be_2OH^{3+} + H^+$; $\log\beta_{1,2} = -3.22 \pm 0.05$ (B = 0.04 to 0.32 M), -3.18 ± 0.03 (B = 0.64 M), -3.15 ± 0.03 (B = 1 M). (auth)

9989 CONTRIBUTION TO THE KNOWLEDGE OF ATMOSPHERIC AEROSOLS. A. Goetz (California Inst. of Tech., Pasadena) and O. Preining. Acta Phys. Austriaca, 14: 305-12(1961). (In German)

Six natural aerosols from different locations were investigated. Five of them proved to be unstable after sampling on polished chromium plated foils. The number of the deposited particles decreased drastically upon storage or temperature treatment. This instability could be caused by evaporation or chemical change (oxidation) of the particles. Hence the particles are not stable after deposition; one could suspect they are not stable while airborne either. (auth)

9990 CHARACTERIZATION OF THE OXIDATION DEGREE OF URANIUM(V) BY THE ABSORPTION SPECTRA IN THE VISIBLE AND THE NEAR INFRARED IN NON-AQUEOUS SOLUTION. Gerard Kaufmann and Raymond Rohmer (Faculté des Sciences and Ecole Nationale Supérieure de Chimie, Strasbourg). Bull. soc. chim. France, No. 10, 1969-73(Oct. 1961). (In French)

It is known that the halogenides and oxyhalogenides of pentavalent uranium disproportionate almost instantaneously in water. Solvents other than water were sought in which this disproportion can be slowed in order to show pentavalent uranium. In the oxygenated solvent disproportionation is almost as fast as in water. This is not the case in solvents such as chloroform and bromoform in which pentavalent uranium could be characterized before its disproportionation. (tr-auth)

9991 THERMODYNAMIC PROPERTIES AND GEOCHEMISTRY OF ISOTOPIC COMPOUNDS OF SELENIUM. H. R. Krouse and H. G. Thode (McMaster Univ., Hamilton, Ont.). Can. J. Chem., 40: 367-75(Feb. 1962).

Using normal vibration equations and statistical mechanics, the isotopic vibrational frequencies and the partition function ratios for various Se^{76}- and Se^{82}-containing compounds were calculated. The equilibrium constants for selenium isotope exchange reactions derived from these partition function ratios indicate that noticeable fractionation of selenium isotopes can be expected in the laboratory and in naturally occurring processes. The Se^{82}/Se^{76} ratios for 16 natural samples were compared mass spectrometrically. Variations of up to 1.5% found in this ratio are discussed. A kinetic isotope effect of 1.5% found in a chemical reduction of selenite ion to elemental selenium is also discussed. (auth)

9992 REACTION OF NIOBIUM WITH XYLENOL ORANGE. A. K. Babko and M. I. Shtokalo (Inst. of General and Inorganic Physics, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 9, 1179-82 (1961). (In Ukrainian)

The reaction of niobium with xylenol orange was studied. It is shown that oxalic acid strongly furthers the formation of a colored complex of niobium with XO. It is supposed that oxalic acid causes the decomposition of polyions of niobium, after which the monometric ions form a complex with XO. Heating considerably accelerates this process. The optimal reaction conditions are pH 2; $Nb : H_2C_2O_4$ ratio 1:5. A large excess of oxalic acid causes a certain attenuation of the color. The absorption spectra indicate the direct formation of a complex with $\lambda = 530\ \mu\mu$ and a molar coefficient of absorption $E \approx 30000$. (auth)

9993 PHYSICO-CHEMICAL ANALYSIS OF SYSTEMS OF CERTAIN RARE-EARTH ELEMENTS WITH GLUCONIC ACID IN AQUEOUS SOLUTIONS. N. A. Kostromina (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 9, 1182-6(1961). (In Ukrainian)

The system rare-earth element–gluconic acid is arbitrarily represented as a four-component system with three reacting components: metal ion, hydrogen ion, and trivalent anion of gluconic acid. The composition of the system is represented by a tetrahedron the base of which is $M^{3+}-H^{+}-A^{3-}$ and the apex is water. A quantitative study was made of two sections of the tetrahedron: $M^{3+}-H_2A^{-}-H_2O$ (M = La, Nd, or Yb) by the method of ion exchange and $MA^{0}-H^{+}-H_2O$ (M = La, Nd, Sm, Gd, Y, or Yb) by the method of potentiometric titration. Diagrams of complex formation were constructed, establishing the domination fields of complexes in systems with lanthanum and ytterbium. (auth)

9994 PHYSICO-CHEMICAL STUDIES OF PRASEODYMIUM HYDROXIDE REACTION WITH H_2O_2. S. Z. Makarov, L. V. Ladeinova-Soboleva, and A. M. Chernyshova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 12, 2109-15(Dec. 1961). (In Russian)

Two solid phases of peroxide, $Pr_2O_4 \cdot 2H_2O$ and $Pr_2O_4 \cdot H_2O$, were observed in $Pr(OH)_3$ reactions with H_2O_2 in a wide concentration range at 0° and 20°C. The compounds are not readily dehydrated by alcohol, ether, or heating. The solid phases are considered to be of a hydroperoxide type. (R.V.J.)

9995 REDUCTION OF CeO_2 IN CH_3COOH KETONIZATION. A. M. Rubinshtein, A. A. Slinkin, V. I. Yakerson, and E. A. Fedorovskaya (Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 12, 2235-7(Dec. 1961). (In Russian)

Analysis of various CeO_2 specimens demonstrated the reduction of Ce^{4+} to Ce^{3+} with simultaneous CH_3COOH oxidation. (R.V.J.)

9996 MAGNETIC RESONANCE PROPERTIES OF YTTRIUM FERRITE GARNETS DURING Y^{3+} REPLACEMENT BY Tb^{3+}, Nd^{3+}, AND Lu^{3+}. K. P. Belov and L. A. Malevskaya (Moscow State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1371-5(Nov. 1961). (In Russian)

The magnetic resonance characteristics of yttrium ferrite garnets completely or partially substituted with terbium, neodymium, or lutetium ions were studied in order to determine the effects of yttrium complex structure. (R.V.J.)

9997 SOLUBILITY OF URANYL, BERYLLIUM, AND CERIUM PHOSPHATES. V. G. Chukhlyantsev and K. V. Alyamovskaya (Kirov Urals Polytechnic Inst., USSR). Izvest. Vysshikh Ucheb. Zavedenii, Khim. i Khim. Tekhnol., 4: 359-63(1961). (In Russian)

The solubilities of uranyl, beryllium, cerium(III), cerium(IV), and beryllium-ammonium phosphates in diluted nitric, hydrochloric, and sulfuric acid solutions were studied at various pH. Calculations of the solubility products for $(UO_2)_3(PO_4)_2$, $Be_3(PO_4)_2$, $CePO_4$, $Ce_3(PO_4)_4$, and $BeNH_4PO_4$ at 19 to 20°C resulted in constants of $(8.2 \pm 5.5) \times 10^{-50}$ for uranyl $(1.9 \times 0.8) \times 10^{-38}$ for beryllium $(2.2 \pm 1.0) \times 10^{-20}$ for beryllium ammonium, $(4.7 \pm 1.2) \times 10^{-22}$ for cerium(III) and $(7.2 \pm 5.3) \times 10^{-91}$ for cerium(IV) phosphates. (R.V.J.)

9998 REACTIONS OF MINERALS CONTAINING RARE EARTH ELEMENTS WITH SALTS AND OXIDES IN SINTERING AND MELTING PROCESSES. VI. ON THE REACTION OF SPODUMENE WITH SODIUM SULFATE. V. E. Plyushchev (Moscow Inst. of Fine Chemical Technology). Izvest. Vysshikh Ucheb. Zavedenii, Khim i Khim. Tekhnol., 4: 463-70(1961). (In Russian)

Thermographic, x-ray diffraction, and optical analyses were made of α and β spodumene reactions with Na_2SO_4 at 700 to 1000°C. The reaction mechanism was compared with the reaction between spodumene and K_2SO_4. (R.V.J.)

9999 DIFFUSION OF Kr AND He IN LIQUID HYDROGEN. G. Cini Castagnoli (Università, Rome). J. Chem. Phys., 35: 1999-2001(Dec. 1961).

Experimental results about diffusion of He and Kr in liquid H_2 are given. The diffusion coefficient measurements were made on a 10^{-5}% mixture of Kr^{85} in H_2 at 19.6°K, and on a mixture of about 1% He^4 at 15 to 20°K. Quantum deviations were analyzed with the principle of corresponding states. Data are tabulated. (P.C.H.)

10000 GASEOUS DIFFUSION IN POROUS MEDIA AT UNIFORM PRESSURE. R. B. Evans, III (Oak Ridge National Lab., Tenn.), G. M. Watson, and E. A. Mason. J. Chem. Phys., 35: 2076-83(Dec. 1961).

A model is presented for the diffusion of gases in porous media in the absence of pressure gradients, in which the porous medium is visualized as a collection of uniformly distributed dust particles which are constrained to be stationary. By formally considering the dust particles as giant molecules, it is possible to derive all the desired results very simply from rigorous kinetic theory as special cases of multicomponent mixtures. By formally varying the mole fractions of the real gas molecules, the entire pressure range from the Knudsen region to the normal diffusion region can be covered. This model permits the first satisfactory theoretical derivation of the experimentally discovered fact that the flux ratio for binary mixtures is equal to $(m_2/m_1)^{1/2}$ at all pressures (not just in the Knudsen region). It also permits a rigorous theoretical treatment of the entire transition region for the first time, from which is obtained the usual Bosanquet interpolation formula and a differential equation for diffusion which covers the entire range (and appears to be new). The model gives no quantitative a priori characterization of the porous medium itself, but if one gas mixture is measured in a given medium, then the behavior of other gas mixtures in the same medium can be predicted. (auth)

10001 NEUTRON DIFFRACTION DATA FOR Ta_2D AND THE PROBABLE ARRANGEMENT OF THE DEUTERIUMS IN TWO OF ITS POLYMORPHIC VARIETIES. W. E. Wallace (Univ. of Pittsburgh). J. Chem. Phys., 35: 2156-64(Dec. 1961).

Neutron diffraction data are presented for Ta_2D at 4 and 78°K, room temperature, and 53°C. The patterns are indexed assuming a pseudocubic unit cell, the cell edge being 6.74 Å at the three lowest temperatures and 3.37 Å at 53°C. The enlarged unit cell in the low temperature (β_1) form is attributed to ordering of the deuteriums in the tetrahedral interstices. Attempts are made to establish the arrangement of the deuteriums (D's) in the β_1 and β_2 forms. For the latter, the stable form at 53°C, the intensities can be accounted for in three ways—by random distribution over $\frac{2}{3}$ (L group), over $\frac{1}{3}$ (S group) or over all of the tetrahedral interstices. From general considerations the first of these is thought to represent the actual situation in β_2-Ta_2D. In this the D's are distributed over the sites at $\frac{1}{2}\ \frac{1}{4}\ 0$, $\frac{1}{2}\ \frac{3}{4}\ 0$, $\frac{1}{4}\ \frac{1}{2}\ 0$, $\frac{3}{4}\ \frac{1}{2}\ 0$ + 000, and + $\frac{1}{2}\ \frac{1}{2}\ \frac{1}{2}$. Analysis of the β_1 pattern shows that despite the fact that this form has a vanishing residual entropy there is no unique configuration of the deuteriums. Instead, to account for the observed intensities a structure must be accepted in which each deuterium is statistically occupying more than one site. Assuming each D to be distributed over two sites three satisfactory structures are obtained. These,

designated A, B, and C, belong to space groups I4, $I\bar{4}$, and $I4_1$, respectively. Structure A seems the most reasonable of the three and hence is accepted as the one which is probably correct. In it the 8 D's are statistically occupying the 16 tetrahedral sites at $\frac{1}{8}\ \frac{1}{4}\ 0$, $\frac{1}{4}\ \frac{7}{8}\ 0$, $\frac{7}{8}\ \frac{3}{4}\ 0$, $\frac{3}{4}\ \frac{1}{8}\ 0$, $\frac{5}{8}\ 0\ \frac{1}{4}$, $\frac{3}{8}\ 0\ \frac{1}{4}$, $0\ \frac{3}{8}\ \frac{1}{4}$, $0\ \frac{5}{8}\ \frac{1}{4}$ + 000, and + $\frac{1}{2}\ \frac{1}{2}\ \frac{1}{2}$. There is an apparent conflict between conclusions based on thermodynamic work and those developed from analysis of the diffraction data for the β_2 form as well as for the β_1 form. The observed configurational entropies of both forms are much less than those expected for the accepted structures. The discrepancies are thought to be due to local order. (auth)

10002 PROTON MOTIONS IN SOLIDS BY SLOW NEUTRON SCATTERING CROSS SECTIONS. J. J. Rush, T. I. Taylor, and W. W. Havens, Jr. (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 35: 2265-6(Dec. 1961). (BNL-5565)

Total neutron cross section measurements were obtained at room temperature for polycrystalline KH_2PO_4, $(NH_4)_2CrO_4$, $(NH_4)_2Cr_2O_7$, NH_4CNS, and NH_4ClO_4. The cross sections per molecule were corrected for neutron absorption and divided by the number of hydrogen atoms. The cross section slopes observed for $(NH_4)_2CrO_4$ and NH_4CNS, 5.5 and 5.8 b/A-H, indicated a hindrance to rotation of the ammonium ion in these compounds. A significant comparison was made between cross section curves for $(NH_4)_2CrO_4$ and $(NH_4)_2Cr_2O_7$. The slope of the dichromate curve was almost double that for the chromate, thus indicating a much greater freedom of rotation and weaker hydrogen bonding for the ammonium ion in this compound. It was noted that the long wavelength cross section and slope for NH_4ClO_4 were significantly greater than those obtained for $(NH_4)_2Cr_2O_7$. There was also evidence for almost free rotation of the ammonium ion in NH_4ClO_4. (P.C.H.)

10003 VAPOR PRESSURES OF SCANDIUM, YTTRIUM, AND LANTHANUM. R. J. Ackermann and E. G. Rauh (Argonne National Lab., Ill.). J. Chem. Phys., 36: 448-52(Jan. 15, 1962).

The vapor pressures of scandium, yttrium, and lanthanum were measured by the effusion method with a vacuum balance, and the heats of vaporization were measured with a mass spectrometer. The data are represented by scandium: $\log p\ (atm) = (5.44 \pm 0.07) - (17020 \pm 90)/T$; yttrium: $\log p\ (atm) = (5.59 \pm 0.07) - (19950 \pm 90)/T$; and lanthanum: $\log p\ (atm) = (6.08 \pm 0.09) - (21940 \pm 150)/T$. The errors quoted are standard deviations. The heats of vaporization are 77.9 ± 0.4, 91.3 ± 0.4, and 100.4 ± 0.7 kcal $mole^{-1}$ for scandium, yttrium, and lanthanum, respectively, and the corresponding entropy changes are 24.9 ± 0.3, 25.6 ± 0.3, and 27.8 ± 0.4 eu. (auth)

10004 HYDROGEN–DEUTERIUM KINETIC ISOTOPE EFFECT AT VERY HIGH TEMPERATURE. Harold S. Johnston and Eugene Tschuikow-Roux (Univ. of California, Berkeley). J. Chem. Phys., 36: 463-8(Jan. 15, 1962).

The kinetic isotope effect for the reaction $CF_3 + CH_2D_2 \rightarrow CF_3H + CHD_2$ or $CF_3D + CH_2D$ was studied in a shock tube between 1000 and 2000°K where CF_3 radicals were produced by thermal decomposition of $CF_3N_2CF_3$. In the reaction zone gas compositions were: noble gases $\gg CH_2D_2 \gg CF_3N_2CF_3$; and in this way ratio of final products CF_3H/CF_3D was equal to the ratio of rate constants k_H/k_D. The data are represented empirically by $\ln k_H/k_D = \ln 1.400 + 0.42 \times 10^6/T^2$. A London-Polanyi-Eyring-Sato potential energy surface was constructed, where Sato's parameter was fitted to give the correct activation energy, and the frequencies and zero-point-energy of the activated complex were then found from curvatures through the saddlepoint of the potential energy surface. At very high temperatures activated complex theory predicts $\ln k_H/k_D = \ln 1.402 + 0.502 \times 10^6/T^2 - 0.069 \times 10^{12}/T^4$, in fair agreement with experiment. (auth)

10005 INTENSITIES OF VIBRATIONAL AND ROTATIONAL SPECTRA OF CHARGED DIATOMIC MOLECULES. Frank O. Ellison (Carnegie Inst. of Tech., Pittsburgh). J. Chem. Phys., 36: 478-80(Jan. 15, 1962).

It is shown that there exists a contribution to the transition moment (and hence to the spectral intensity) associated with pure rotational and with vibration-rotational transitions which is proportional to the net charge residing on the molecule and to the difference in masses of the nuclei. Hence, molecule-ions such as HD^+ and $(Cl^{35}Cl^{37})^+$ should absorb and emit dipole radiation with significant intensity in the vibrational and rotational spectral regions. (auth)

10006 INFLUENCE OF ION SIZE UPON THE INTENSITY OF Eu^{3+} FLUORESCENCE IN THE TUNGSTATES. L. G. Van Uitert and R. R. Soden (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 36: 517-19 (Jan. 15, 1962).

Comparisons of the fluorescence of Eu^{3+} in a number of related tungstates show that under long-wave ultraviolet excitation comparable series (M^{2+} tungstates or $M^{+}_{0.5}M^{3+}_{0.5}$ tungstates with a fixed Eu^{3+} content) show a logarithmic dependence of emission intensity upon the average volume of the ions in the structure. (auth)

10007 PREPARATION OF LANTHANIDE AND ACTINIDE MONOSULFIDES BY FUSED SALT ELECTROLYSIS. R. Didchenko and L. M. Litz (Parma Research Center, Union Carbide Corp., Parma, Ohio). J. Electrochem. Soc., 109: 247-50(Mar. 1962).

The monosulfides of the metals in the lanthanide and actinide series may be prepared by the electrolytic reduction of the higher sulfides in an oxygen-free, fused salt medium that contains the chloride of the metal in question. A detailed description of the preparation of CeS and ThS is given, and possible reaction mechanisms are discussed. (auth)

10008 THE VAPOUR-PRESSURES AND OTHER PROPERTIES OF ReF_6 AND ReF_7. J. G. Malm and H. Selig (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 20: 189-97(Dec. 1961).

Vapor pressures of ReF_6 and ReF_7 were measured. The vapor pressures are represented by the following equations: ReF_6: solid I (–10.47- –3.45°C) $\log_{10} p = -(2303.6/T) - 0.8327 \log_{10} T + 12.70721$; solid II (–3.45°C-18.5°C) $\log_{10} p = -(1765.4/T) - 0.1790 \log_{10} T + 9.12298$; liquid (18.5°-48.06°C) $\log_{10} p = -(1956.7/T) - 3.599 \log_{10} T + 18.20814$. ReF_7: solid (–14.47°-48.3°C) $\log_{10} p = -(2205.8/T) - 1.4703 \log_{10} T + 13.04321$; liquid (48.3-74.61°C) $\log_{10} p = -(244.28/T) + 9.90825 \log_{10} T - 21.58352$. Values for the heats of vaporization and heats of transition are given. ReF_6 undergoes a solid-solid transition at –3.45°C and melts at 18.5°C. ReF_7 melts at 48.3°C. Some chemical properties of these compounds are described. (auth)

10009 HEAT STABILITIES OF THE ALKALINE EARTH CHELATES DERIVED FROM 8-HYDROXYQUINOLINE. R. G. Charles (Westinghouse Research Labs., Pittsburgh). J. Inorg. & Nuclear Chem., 20: 211-21(Dec. 1961).

The anhydrous alkaline earth chelates derived from 8-hydroxyquinoline, when heated in the absence of air, decompose in the vicinity of 500°C with the evolution of H_2.

At least a portion of the metal chelate ring systems appears to be retained in the pyrolysed residues. The order of decreasing heat stability for the chelates is Ca > Mg > Sr > Ba. All of the chelates are more heat stable than is 8-hydroxyquinoline itself. (auth)

10010 THE COMPOUND $UCl_5 \cdot PCl_5$. R. E. Panzer (Univ. of New Mexico, Albuquerque) and J. F. Suttle. J. Inorg & Nuclear Chem., 20: 229-41(Dec. 1961).

$UCl_5 \cdot PCl_5$ is obtained as bright red-orange, tabular twinned crystals of triclinic symmetry. Evidence that this compound is ionized in $POCl_3$ as PCl_4^+ and UCl_6^- is given by electrolyses in which UCl_6 is liberated at the anode and PCl_5 and PCl_5 at the cathode. From the anolyte, the compound $2UCl_4 \cdot UCl_6 \cdot 6POCl_3$ was recovered. This compound was also obtained in $UCl_5 \cdot PCl_5 - POCl_3$ solutions reacted with about 1% water. Optical crystallographic and x-ray powder pattern data were obtained for these compounds. (auth)

10011 STABILIZATION OF UO_2. W. B. Wilson (General Electric Co., Detroit), C. A. Alexander, and A. F. Gerds. J. Inorg. & Nuclear Chem., 20: 242-51(Dec. 1961).

Uranium dioxide, when exposed at elevated temperatures to an oxidizing atmosphere, will transform to U_3O_8. This compound exhibits appreciable vapor-pressure at temperatures in excess of 1200°C. The need for a stable high-temperature material requires prevention of the U_3O_8 transformation and, in certain applications, a lowering of the vapor-pressure. A method by which this may be accomplished is discussed. Solid-state studies of the uranium-lanthanum-oxygen (and the uranium-yttrium-oxygen) systems were conducted in the present investigation to elicit more detailed understanding of the factors involved. The oxidation and vaporization characteristics of uranium oxide were compared directly to those of solid solutions of uranium oxide containing up to approximately 60 mole % R_2O_3 additive, as La_2O_3 or Y_2O_3. These solid solutions, which have the fluorite structure, were formed by reacting UO_2 and R_2O_3 in vacuo. When these materials were oxidized, the fluorite structure was retained, with reduced lattice parameter. The volatile losses of solid solutions, as well as the oxidation state of the uranium, were found to vary inversely with the amount of the additive. Data are presented toward establishing: lattice parameters and electrical characteristics of the reduced and oxidized solid solutions, static weight losses of the oxides as a function of additive content, the oxidation state of the uranium in the solid solutions, and vapor-pressure results. (auth)

10012 OBSERVATIONS ON THE RARE EARTHS. LXXIII. THE HEAT AND ENTROPY OF FORMATION OF THE 1:1 CHELATES OF N-HYDROXYETHYLETHYLENEDIAMINETRIACETIC ACID WITH THE TRIPOSITIVE CATIONS. T. Moeller and R. Ferrûs (Univ. of Illinois, Urbana). J. Inorg. & Nuclear Chem., 20: 261-73(Dec. 1961).

Enthalpy changes in the formation of N-hydroxyethylethylenediaminetriacetic acid (H_3HEDTA) chelates of the tripositive rare-earth metal ions are evaluated by the temperature coefficient method for aqueous solutions of ionic strength 0.1(KNO_3). Corresponding entropy changes are calculated from the enthalpy changes and stability constants at 25°. Values of enthalpy and entropy changes for the formation of $Ca(HEDTA)^-$, $Cu(HEDTA)^-$, and $Cu(tren)^{2+}$ are obtained also. An interpretation of data for the rare-earth metal chelates is offered and extended to other published data. Consideration of both translational and configurational entropy changes is shown to be necessary, and the importance of the latter in these complexes is emphasized. (auth)

10013 THE COMPOSITION OF SOME NITRATO NITROSYLRUTHENIUM COMPLEXES. R. M. Wallace (E. I. du Pont de Nemours & Co., Aiken, S. C.). J. Inorg. & Nuclear Chem., 20: 283-9(Dec. 1961).

Isolation and analysis of some of the nitrato complexes of nitrosylruthenium existing in nitric acid solutions has permitted identification of the complexes. The complex that is most extractable in tri-n-butyl phosphate (TBP) was shown to be trinitrato nitrosylruthenium $[RuNO(NO_3)_3(H_2O)_2]$; other extractable species contained fewer than three nitrato groups. Three cationic species, which were isolated by ion exchange techniques, were shown to be dinitrato, mononitrato, and nonnitrato nitrosylruthenium with the probable formulas $[RuNO(NO_3)_2(H_2O)_3]^+$, $[RuNO(NO_3)(H_2O)_4]^{2+}$, and $[RuNO(H_2O)_5]^{3+}$, respectively. A study of the complexes adsorbed by anion exchange resins indicated the absorbed species to be a mixture of complexes some of which contained more than three nitrato groups per ruthenium atom. (auth)

10014 THE PREPARATION AND SPECTRUM OF TETRABUTYL AMMONIUM URANYL DIBUTYL PHOSPHATE $[Bu_4N\ UO_2(DBP)_3]$. J. Kennedy and A. M. Deane (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 20: 295-9(Dec. 1961). (AERE-R-3614)

The double salt $Bu_4N\ UO_2(DBP)_3$[where DBP = $(BuO)_2POO$] is prepared. Infrared data for this species and comparison of its spectrum with that of $UO_2(DBP)_2 \cdot HDBP \cdot TOPO$ (where TOPO = trioctyl phosphine oxide) inclines us to the view that the latter is the oxonium salt TOPO $H^+[UO_2(DBP)_3]^-$. Slow evaporation of a solution of $UO_2(DBP)_2 \cdot 2HDBP$ in carbon tetrachloride results in the formation of crystalline $UO_2(DBP)_2$. (auth)

10015 INFRA-RED SPECTRA OF WATER IN TRIBUTYL PHOSPHATE CONTAINING DISSOLVED SALTS, AND THE EFFECTS OF SOLUTES ON THE TRIALKYL PHOSPHATE SPECTRUM. L. I. Katzin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 20: 300-3(Dec. 1961).

Data are presented on shifts of infra-red spectral peaks for the phosphoryl group of tributyl phosphate when various salts are co-ordinated. The effects of dissolved salts on the spectrum of water present in the phosphate are also pointed out. (auth)

10016 CHARACTERISTICS OF THE SOLVATES OF THE RARE-EARTH ACETYLACETONATES. G. W. Pope, J. F. Steinbach, and W. F. Wagner (Univ. of Kentucky, Lexington). J. Inorg. & Nuclear Chem., 20: 304-13(Dec. 1961).

Chemical analyses, x-ray diffraction patterns, vapor-pressure studies, and cryoscopic molecular weight determinations of nine rare-earth acetylacetonates prepared by conventional methods show that only two hydrates are formed: the monohydrate and the trihydrate. None of the conventional methods of preparation and drying yielded the anhydrous rare-earth acetylacetonates. Vapor pressure studies showed the formation of a solvate containing two moles of methanol per mole of chelate. Values of ΔH for the decomposition of the methanol disolvate indicate that the bond energy between the chelate and methanol is equivalent to strong hydrogen bonding. Solubility and cryoscopic molecular weight studies show that the chelates dissolve in benzene to form the monobasic compounds which polymerize, especially upon heating. (auth)

10017 AMMONIUM, POTASSIUM, RUBIDIUM AND CESIUM HEXAVANADATES. A. D. Kelmers (Union Carbide Nuclear Co., Tuxedo, N. Y.). J. Inorg. & Nuclear Chem., 21: 45-8(Dec. 1961). (In English)

The following anhydrous alkali hexavanadates were prepared and are shown to be isostructural: $K_2V_6O_{16}$, $(NH_4)_2V_6O_{16}$, $Rb_2V_6O_{16}$ and $Cs_2V_6O_{16}$. They are monoclinic and contain six vanadium atoms per unit cell. The crystal lattice undergoes a linear expansion in the a and e dimensions as the ionic radius of the cation increases. The hexavanadates of lithium and sodium could not be prepared. (auth)

10018 THE INTERACTION OF $NO_2-N_2O_4$ AND CERTAIN METALLIC OXIDES: TERBIUM SESQUIOXIDE, LANTHANUM OXIDE, VANADIUM SESQUIOXIDE AND PEROVSKITE PHASE $PrCrO_3$. F. Vratny (Purdue Univ., Lafayette, Ind.). J. Inorg. & Nuclear Chem., 21: 77-91 (Dec. 1961). (In English)

The interaction of $NO_2-N_2O_4$ with terbium sesquioxide, lanthanum oxide, vanadium sesquioxide, and perovskite phase $PrCrO_3$ was studied as a function of the temperature of interaction and the pressure of NO_2. Two methods of investigation were employed: analysis of the reacted species and the infrared spectra of the reacted products. It was found that the interaction leads to oxidation, nitration, and nitrition as competing processes. (auth)

10019 THE REACTION OF PuF_4 WITH OXYGEN. C. J. Mandleberg, D. Davies, and K. E. Francis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 21: 92-5(Dec. 1961). (In English)

The reaction of PuF_4 with dry oxygen was studied at 750 to 900°C. There was some evidence for the production of PuF_6, but if this is formed, the rate of reaction is several orders of magnitude slower than that of the corresponding reaction of UF_4 with oxygen. PuF_4 does, however, appear to be volatile in a stream of oxygen at these temperatures. No trace of plutonium oxide was found in the residue. (auth)

10020 ION EXCHANGE PROPERTIES OF ZIRCONYL PHOSPHATES. I. CONTRIBUTION TO THE STRUCTURE OF ZIRCONYL PHOSPHATES. L. Baetslé and J. Pelsmaekers (Belgian Nuclear Research Center, Mol). J. Inorg. & Nuclear Chem., 21: 124-32(Dec. 1961). (In English)

Chemical and x-ray investigation on zirconyl phosphates led to the elucidation of some aspects of the structure of a crystalline compound with a constant phosphate/zirconium ratio of 5/3. The ion-exchange properties of this compound were investigated by studying the mode of dissociation and the total exchange capacity. The total capacity amounts to 4.3 ± 0.10 meq/g at pH = 7.5 and the capacity-composition curve indicates that in acid and neutral media the phosphate groups only are responsible for the exchange capacity. A crystallographic investigation led to the determination of a cubic structure with parameter a = 9.04 Å. In conjunction with density measurement it was possible to calculate the molecular weight of one chain unit (M = 878). (auth)

10021 ION EXCHANGE PROPERTIES OF ZIRCONYL PHOSPHATES. II. ION EXCHANGE EQUILIBRIA ON ZIRCONYL PHOSPHATE. L. Baetslé and D. Huys (Belgian Nuclear Research Centre, Mol). J. Inorg. & Nuclear Chem., 21: 133-40(Dec. 1961). (In English)

The tracer ion exchange equilibria $Cs^{134}-H^+$, $Rb^{86}-H^+$, $Sr^{89}-H^+$, $Eu^{152}-H^+$, $Cs^{134}-NH_4^+$, $Sr^{89}-Na^+$, and $Sr^{89}-NH_4^+$ on zirconyl phosphate were studied in the concentration range 0.001 to 0.5M; all obey the mass action law except the $Sr^{89}-Na^+$ equilibrium. The distribution coefficients indicate that a selective separation of Cs^{137} from a 0.2M HNO_3 fission product solution can be effected with a very high decontamination factor. Some macro-exchange systems were studied in order to evaluate the interference of macroquantities of cations on zirconyl phosphate in the H^+ form. The equilibrium constants of the systems Na^+-H^+, K^+-H^+, $Ca^{2+}-H^+$, and $Sr^{2+}-H^+$ are very low, but the difference between the constants of two neighboring cations is relatively large. The adsorption affinity series of the ions in acid solution seems to differ slightly from the lyotropic series, NH_4^+ and H^+ ions displaying an uncommon behavior. (auth)

10022 AQUEOUS SYSTEMS AT HIGH TEMPERATURE. II. LIQUID-LIQUID IMMISCIBILITY IN THE SYSTEM $UO_3-SO_3-N_2O_5-H_2O$ ABOVE 300°C. C. J. Barton, G. M. Hebert, and William L. Marshall (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 21: 141-51(Dec. 1961). (In English)

Apparatus suitable for the observation of liquid-liquid immiscibility in solution sealed in silica tubes is described. Immiscibility temperatures are reported for 0.04, 0.08, and 0.16 molal uranyl solutions in the system $UO_3-SO_3-N_2O_5-N_2O$. A comparison of the effect of nitric and sulfuric acids on the immiscibility temperature of uranyl sulfate solutions on the basis of total added hydrogen ion shows that at low acidity nitric acid produces a greater increase in immiscibility temperature than sulfuric acid and at high acidity sulfuric acid becomes more effective than nitric acid. In solutions containing low concentrations of excess acid, the substitution of nitrate for sulfate raises the immiscibility temperature, but at high acidities the initial substitution lowers the immiscibility temperature. The data seem to indicate that there is an interdependence between acidity and complexing in this system. The data also show that partial substitution of nitrate for sulfate in a sulfate-based aqueous homogeneous reactor fuel at low added acidity may have some advantage in elevating the liquid-liquid immiscibility temperature. Finally, a significant effect of pressure in elevating the immiscibility temperature is reported. (auth)

10023 A SEARCH FOR HYDROGEN–DEUTERIUM EXCHANGE ON CLEAN GERMANIUM SURFACES. D. Shooter and H. E. Farnsworth (Brown Univ., Providence). J. Phys. Chem., 66: 222-4(Feb. 1962).

An attempt was made to measure hydrogen–deuterium exchange on (100) surfaces of a germanium crystal cleaned by outgassing in vacuo and by argon ion bombardment. Tests for the reaction also were made on sputtered films. No activity was found for either type of surface. The lower observable limits of the activity were 10^{13} molecules cm^{-2} sec^{-1} for the crystal and 5×10^{11} molecules cm^{-2} sec^{-1} for the film. It is concluded that the lack of activity cannot be due to contamination of the surface. A comparison is made between this result and other published results for hydrogen–deuterium exchange on germanium. (auth)

10024 THE POLAROGRAPHIC DETERMINATION OF THE FORMATION CONSTANTS OF THE OXALATE COMPLEXES OF COPPER(II) AND CADMIUM(II) IN LIGHT AND HEAVY WATER. Donald L. McMasters, Joseph C. DiRaimondo, Lowell H. Jones, R. Philip Lindley, and Eugene Zeltmann (Beloit Coll., Wis.). J. Phys. Chem., 66: 249-52(Feb. 1962).

The formation constants of the dioxalato cuprate(II) com-

plex and the cadmium(II)-oxalate complexes were determined polarographically in light water (H_2O) and heavy water (D_2O). The over-all formation constant of the dioxalato cuprate(II) complex in light water is 1.87×10^9 ($\log K_2 = 9.27$) and in heavy water is 3.27×10^9 ($\log K_2 = 9.51$). The over-all formation constants for the cadmium(II)-oxalate complexes in light water are 4.10×10^2 for K_1 ($\log K_1 = 2.61$), 1.29×10^4 for K_2 ($\log K_2 = 4.11$) and 1.15×10^5 for K_3 ($\log K_3 = 5.06$). In heavy water the over-all formation constants are 4.60×10^2 for K_1 ($\log K_1 = 2.66$), 1.60×10^4 for K_2 ($\log K_2 = 4.20$) and 1.49×10^5 for K_3 ($\log K_3 = 5.17$). All these constants were determined at $25.0 \pm 0.05°$ and at an ionic strength of 1.00 with sodium nitrate. These results indicate that light water is more strongly solvating than heavy water. (auth)

10025 EFFECT OF SEVERAL PHOSPHATES ON THE CRYSTALLIZATION AND CRYSTAL HABIT OF STRONTIUM SULFATE. Masaji Miura, Sadaichi Otani, Minekazu Kodama, and Kozo Shinagawa (Hiroshima Univ.). J. Phys. Chem., 66: 252-5(Feb. 1962).

The crystallization of strontium sulfate was remarkably retarded when an extremely small amount of sodium pyro- or triphosphate was added to the solution, the habit of the resultant crystals being modified to the spherulitic. The effect of either sodium trimetaphosphate or the orthophosphate was insignificant. The effect of the phosphate on the crystallization rate, estimated by conductometric measurements, was attributed to adsorption of the phosphate on the strontium sulfate crystals. In the case of the pyro- and triphosphates, there was a rapid increase in the amount adsorbed with increasing phosphate concentration. The large differences in adsorption were correlated with the solubilities of the strontium phosphate salts and with the ability of the phosphates to form complexes with strontium. The low values for the amount of trimetaphosphate adsorbed were partially ascribed to the rigidity of its ionic structure, which might prevent its adaptation to the crystal lattice of strontium sulfate. (auth)

10026 RARE EARTH CHELATE STABILITY CONSTANTS OF SOME AMINOPOLYCARBOXYLIC ACIDS. J. L. Mackey, M. A. Hiller, and J. E. Powell (Ames Lab., Ames, Iowa). J. Phys. Chem., 66: 311-14(Feb. 1962). (IS-210)

Stability constants of the complexes formed between the rare earths and 1,2-bis-[2-di-(carboxymethyl)-aminoethoxy]-ethane (EGTA) and 2,2'-bis-[di-(carboxymethyl)-amino]-diethyl ether (EEDTA) were determined by the polarographic and mercury electrode methods at a temperature of 20° and an ionic strength of $\mu = 0.1$. Some of the trends in the stabilities of rare earth aminopolycarboxylate chelates are discussed. (auth)

10027 THE PERMEABILITY OF NIOBIUM TO HYDROGEN. D. W. Rudd, D. W. Vose, and S. Johnson (Metal Hydrides, Inc., Beverly, Mass.). J. Phys. Chem., 66: 351-3(Feb. 1962).

The permeability (P) of niobium to hydrogen was investigated over a range of temperature between 950 to 1065° and pressure levels of 1.1 and 2.0 atmospheres. The resulting permeability was found to obey the relationship $P = 2.01 \times 10^3\ e^{-5208 + 140/RT}$ ($cm^3\ H_2$(0°, 1 atm) $hr^{-1}/cm^2\ mm^{-1}\ (atm)^{½}$). (auth)

10028 URANIUM PEROXIDE HYDRATES. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). Naturwissenschaften, 48: 668(1961). (In English)

In order to determine the water concentration of uranium peroxide hydrates, thermobalance examination, differential thermal analysis, and infrared and x-ray-diffraction studies were made of uranium peroxide hydrates precipitated from aqueous solutions of uranyl nitrate with hydrogen peroxide under various conditions and dried in air at room temperature. It was found that the hydrates exist in two crystalline modifications and the formation of those hydrated depends only on the precipitation temperature. $UO_4 \cdot 4H_2O$ is formed below 50°C, $UO_4 \cdot 2H_2O$ above 70°C, and a mixture of the two at 60°C. The tetrahydrate is converted to the bihydrate by air drying at 100°C or by drying in a vacuum for 24 hrs at room temperature. (J.S.R.)

10029 THERMAL DECOMPOSITION OF URANIUM PEROXIDE HYDRATE. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). Naturwissenschaften, 48: 693(1961). (In English)

The thermal decomposition of $UO_4 \cdot 4H_2O$ and $UO_4 \cdot 2H_2O$ was studied by thermobalance examinations, differential thermal analysis, and x-ray and infrared diffraction. The loss of water on heating was determined with magnesium nitride. It was concluded that the thermal decomposition proceeds by the following sequence: $UO_4 \cdot 4H_2O \rightarrow UO_4 \cdot 2H_2O \rightarrow UO_x \rightarrow UO_3 \rightarrow U_3O_8$. (J.S.R.)

10030 ON PHYSICAL ADSORPTION. XVI. THE PHYSICAL INTERACTION OF H_2, D_2, CH_4, AND CD_4 WITH GRAPHITE. J. P. Olivier and S. Ross (Rensselaer Polytechnic Inst., Troy, N. Y.). Proc. Roy. Soc. (London), A265: 447-54(Feb. 6, 1962).

Data previously determined by others, for adsorption of the isotopic pairs H_2-D_2 and CH_4-CD_4 by graphitized carbon black are interpreted in terms of a theory of the mobile adsorbed film, from which are deduced the potential energy of interaction between adsorbent and adsorbate and changes in translational, rotational, and vibrational kinetic energies of the adsorbate molecules. These quantities are evaluated from the experimental data, and provide a description of the experimental adsorption isotherms and their variation with temperature: the results derived are compared and found to be in agreement with the thermodynamics of the process. The total adsorptive interaction for the systems considered is shown to result from two (and only two) contributions: the London-type dispersion forces between the adsorbate and the adsorbent, and the interaction due to the polarization of the adsorbate by the surface electric field. (auth)

10031 CO-PRECIPITATION OF CERIUM(III) WITH THORIUM OXALATE. D. N. Bykhovskii. Radiokhimiya, 3: 535-43(1961). (In Russian)

Precipitation of Ce III with thorium oxalate was studied using Ce^{144} as tracer. Cerium diffuses into the thorium oxalate crystals during crystallization and into previously formed crystals. The crystals formed during thorium oxalate precipitation in the presence of Ce captures equilibrium quantities of thorium. It is shown that precipitations of Ce^{144} and Th^{234} have different characters related to their equilibrium. (R.V.J.)

10032 CO-PRECIPITATION OF Pu AND Am WITH POTASSIUM SULFATE. V. I. Grebenshchikova and V. N. Bobrova. Radiokhimiya, 3: 544-50(1961). (In Russian)

Co-precipitation of Pu(IV) and Am(III) with potassium sulfate was studied using Pu^{239} and Am^{241} isotopes and chemically pure twice recrystallized potassium sulfate. It is shown that Pu(IV) and Am(III) form mixed crystals with potassium sulfate. The lower miscibility level is at Pu(IV) concentration of 10^{-5} to 10^{-9} M and Am(III) concentrations of 10^{-7} to 10^{-9} M. A high crystallization factor for Pu(IV) and Am(III) makes potassium sulfate a good carrier for transuranium elements. (R.V.J.)

10033 COORDINATION CHEMISTRY OF URANYL COMPOUNDS WITH PHOSPHO-ORGANIC DERIVATIVES CONTAINING GROUP P = O. [PART] I. E. V. Komarov and M. F. Pushlenkov. Radiokhimiya, 3: 567-74(1961). (In Russian)

The compositions of uranyl bromides, chlorides, nitrates, and acetates in solutions with tri-n-butylphosphate were determined. The ether oxygen of TBP does not participate in bond formation with uranyl. The TBP molecular coordination is achieved through the phosphoryl oxygen. The coordination number of uranyl in $UO_2Br_2 \cdot (TBP)_2$ and $UO_2Cl_2 \cdot (TBP)_2$ complexes is 4. The possibility of reducing the coordination number is discussed. (R.V.J.)

10034 COORDINATION CHEMISTRY OF URANYL COMPOUNDS WITH PHOSPHO-ORGANIC DERIVATIVES CONTAINING GROUP P = O. [PART] II. E. V. Komarov and M. F. Pushlenkov. Radiokhimiya, 3: 575-81(1961). (In Russian)

The molecular compositions of uranyl bromides, nitrates, and acetates, with tri-n-butylphosphinic oxide in solutions were determined. It is shown that molecular coordination of TBP and TBPO is identical and can be achieved through the phosphoryl oxygen. It is also shown that the uranyl coordination number in the UO_2Br_2 $(TBPO)_2$ complex and in similar complexes with TBP is 4. The energy aspects of mutual addends in uranyl coordination are analyzed. (R.V.J.)

10035 SPECTROPHOTOMETRIC STUDY OF URANIUM(VI) ACETATE SOLUTIONS. V. I. Paramonova, V. B. Kolychev, and A. V. Vikhlyantsev. Radiokhimiya, 3: 582-8(1961). (In Russian)

Spectrophotometric characteristics of aqueous acetate solutions of U(VI) were investigated. All uranyl acetate complexes possess small coefficients of molar absorption in the visible region that interfere with calculations. The instability constant of $[UO_2Ac]^+$ and the magnitude of the dissociation constant were determined, and the light absorption spectra of $UO_2Ac_2 \cdot 2H_2O$ in organic diluents were analyzed. (R.V.J.)

10036 ON POLYMERIZATION AND SPECIFIC ABSORPTION BY IONITES OF U(VI) IN ACETATE SOLUTIONS. V. I. Paramonova, V. B. Kolychev, and A. V. Vikhlyantsev. Radiokhimiya, 3: 589-92(1961). (In Russian)

Spectrophotometric studies show that neither polymerization nor specific absorption of U(VI) take place in acetate complexes. (R.V.J.)

10037 COMPLEX FORMATION OF Ce, Y, AND UO_2 WITH VARIOUS CHELATE COMPOUNDS. L. M. Razbitnaya and I. A. Korovina. Radiokhimiya, 3: 593-6(1961). (In Russian)

The rate of formation and composition of complex compounds of yttrium(III), cerium(III), and uranium(VI) with diethylenetriaminepenta acetic and ethyl ether-diaminetetraacetic acids were determined by spectrophotometric methods. The saturation method was used to find that the rare earth elements and uranyl at pH = 5.5, μ = 0.2, and concentration 10^{-4} to 10^{-5} M form complex compounds with ion-complex ratios of 1 : 1 in both acids. (R.V.J.)

10038 URANYL NITRATE REACTION WITH AMINES. V. M. Vdovenko, D. N. Suglobov, V. I. Artem'ev, and I. G. Suglobova. Radiokhimiya, 3: 636-7(1961). (In Russian)

Reactions of hydrated uranyl nitrate with mono-, di, and trioctylamine were studied with chloroform, benzene, and ethyl ether diluents. (R.V.J.)

10039 EFFECTS OF CERTAIN VARIABLES ON THE POLARIZATION CAPACITY OF ZIRCONIUM. A. B. Johnson, Tennyson Smith, and George Richard Hill (Univ. of Utah, Salt Lake City). Trans. Faraday Soc., 57: 2299-2307(Dec. 1961).

The polarization capacity of zirconium was measured, using the Wagner ballistic galvanometer method. The following variables were investigated: potential, electrolyte concentration, temperature, surface area, and surface treatment. The capacity of the potential minimum was 2.6 ± 0.2 $\mu F/cm^2$. Changes in capacity with time after etching or abrading were interpreted in terms of oxide-film growth. (auth)

10040 RADIOACTIVE STUDIES OF DIFFUSION IN POLYMER SYSTEMS. PART 3. SORPTION AND SELF-DIFFUSION IN THE ACETONE + CELLULOSE ACETATE SYSTEM. G. S. Park (Courtaulds Ltd., Maidenhead, Berks, Eng.). Trans. Faraday Soc., 57: 2314-22(Dec. 1961).

The self-diffusion coefficient D^* of acetone in cellulose acetate was obtained at 30°C and at volume fractions of acetone between 0.15 and 0.25 by an isotopic tracer technique and compared with the chemical diffusion coefficient D obtained from the first stage of the two-stage sorption kinetics. Provided that d log V/d log a (where a is the thermodynamic activity and V is the volume fraction of the acetone) is obtained from pseudo-equilibrium data given by the extent of the first stage in the two-stage sorption process, the relationship $D^* = (1 - V)^{-3} D$ d log V/d log a holds within experimental error. Cellulose acetate exhibits hysteresis in its equilibrium vapor sorption characteristics, but measured values of D^* or values calculated from D are shown to be independent of a provided V is constant. (auth)

10041 THE CHEMISTRY OF THE URANIUM FLUORIDES. I. V. Tananaev, N. S. Nfkolaev, Yu. A. Luk'yanychev, and A. A. Opalovskii (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Uspekhi Khim., 30: 1490-1522(Dec. 1961). (In Russian)

The preparation of UF_3 by reduction with H_2 or Al is described. The lattice parameters and chemical properties of UF_3 are summarized. Three general methods of preparing UF_4 are presented. UF_4 can be precipitated from aqueous solution by electrolysis or by using a reducing agent such as $SnCl_2$, CuCl, or SO_2 plus HCOOH in the presence of HF or NH_4F. The second type of method depends on the fluorination of UO_2 with HF at high temperature or the direct fluorination of UO_3 with various "freons." The third type of method depends on the reduction of UF_6 by H_2, gaseous HCl, HBr or HI, or by reduction with CCl_4. Data on the crystal hydrated, lattice parameters, vapor pressure, heat capacity, enthalpy and entropy of UF_4 are presented. The reactions of UF_4 with H_2O, O_2, ClF_3 and BrF_3, and the reduction of UF_4 with Mg to U are summarized. Phase diagrams are presented for the systems $LiF - UF_4$, $NaF - UF_4$, and $NaF - ZrF_4 - UF_4$. The preparation and thermodynamic properties of intermediate fluorides such as UF_5, U_2F_9, and U_4F_{17} are given. Methods of preparation, thermodynamic properties and chemical reactions of UF_6 are summarized. The properties of UO_2F_2 are described. 175 references. (TTT)

10042 IMPROVEMENTS IN AND RELATING TO THORIUM DISILICIDE. Allan Brown and John Jephson Norreys (to General Electric Co., Ltd.). British Patent 889,775. Feb. 21, 1962.

A new phase of $ThSi_2$, the beta phase, was prepared by

a short heat treatment of alpha $ThSi_2$ at 700 to 1050°C, and slurries of this beta phase in Bi and Bi–Pb were successfully produced. Slurries of this type should be suitable for use as breeding materials in reactors. (D.L.C.)

10043 METAL PHTHALOCYANINES. Norman A. Frigerio (to U. S. Atomic Energy Commission). U. S. Patent 3,027,391. Mar. 27, 1962.

A process is given for preparing heavy metal phthalocyanines, sulfonated or not. The process comprises mixing an inorganic metal salt with dimethyl formamide or methyl sulfoxide; separating the metal complex formed from the solution; mixing the complex with an equimolar amount of sodium, potassium, lithium, magnesium, or beryllium sulfonated or unsulfonated phthalocyanine whereby heavy-metal phthalocyanine crystals are formed; and separating the crystals from the solution. Uranyl, thorium, lead, hafnium, and lanthanide rare earth phthalocyanines can be produced by the process. (AEC)

Radiation Chemistry and Radiochemistry

Refer also to abstracts 9754 and 10417

10044 (AD-259539) RESEARCH ON RADIATION-INDUCED FREE RADICALS OF SHORT LIFETIME. Technical Report No. 1. M. Weissbluth and D. Scalapino (Stanford Univ., Calif. Biophysics Lab.). June 1961. Contract Nonr-225(36). (BL-21)

The detection and study of short-lived free radical intermediates produced by beams of high-energy electrons are described. The Stanford Mk IV electron linear accelerator was the source of high energy electrons and the detection method employed the techniques of electron paramagnetic resonance (epr) spectrometry. Technical problems associated with the study of the kinetics of free radical intermediates when these are produced by beams of high energy electrons are examined. These problems arise from the fact that in irradiation of a given sample, other components of the system are irradiated; the result is interference with the detection apparatus. Another problem arises from lack of sufficient radiation dose in the sample during a pulse. The indications were that in sufficient concentrations, shorter lived events, to approximately 0.2 sec would be detectable by the same apparatus. (auth)

10045 (CRC-1066) MOLECULAR INTERACTIONS IN THE RADIOLYSIS OF LIGHT AND HEAVY HYDROCARBONS. P. J. Dyne, W. M. Jenkinson, and J. Denhartog (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1961. 16p. (AECL-1416)

Measurements were made of the isotopic composition of radiolytic hydrogen evolved from mixtures of cyclohexane-d_{12} or benzene-d_6 with various hydrocarbons. The data are interpreted in terms of first-order processes of the kinetic form $C_6D_{12} \rightsquigarrow C_6D_{10} + D_2$ and second-order processes, $C_6D_{12} \rightsquigarrow X_D + R$, $X_D + C_6H_{12} \rightarrow HD + R$. The efficiency of the first-order process from cyclohexane varies markedly with the hydrocarbon; the yield of D_2 from a solution of C_6D_{12} in cyclopentane is four times that from solutions of C_6D_{12} in cyclohexane. A complete kinetic analysis for the system C_6D_6–C_6H_6 was made from measurements at the two ends of the concentration range. This gives a satisfactory prediction of the isotopic composition of hydrogen evolved from an equimolar C_6H_6–C_6D_6 mixture. A first-order yield of D_2 is found in solutions of C_6D_{12} in benzene which persists to "zero" C_6D_{12} concentration. The mechanisms of the first-order process studied in these experiments, and of the "unscavengeable" or "molecular" yields of radiolytic hydrogen, are discussed. (auth)

10046 (NAS-NS-3051) THE RADIOCHEMISTRY OF NICKEL. L. J. Kirby (General Electric Co. Hanford Atomic Products Operation). Nov. 1961. 62p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The radiochemistry of nickel is discussed including a review of nuclear and chemical features. An outline of the problems of dissolution of a sample and counting techniques, and a collection of radiochemical procedures for the element as found in the literature. (M.C.G.)

10047 (NAS-NS-3052) THE RADIOCHEMISTRY OF PALLADIUM. Ove T. Hoegdahl (Univ. of Michigan). Dec. 1961. 68p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

Included in the volume are sections in which a review of the nuclear and chemical features of particular interest to the radiochemist, discussions of dissolution and counting techniques, and a collection of radiochemical procedures are presented. (J.R.D.)

10048 (NAS-NS-3053) THE RADIOCHEMISTRY OF RUBIDIUM. G. W. Leddicotte (Oak Ridge National Lab.). [1962]. 51p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

Included in the volume are sections in which a review of the nuclear and chemical features of particular interest to the radiochemist, discussions of dissolution and counting techniques, and a collection of radiochemical procedures are presented. (J.R.D.)

10049 (NAS-NS-3054) THE RADIOCHEMISTRY OF SULFUR. G. W. Leddicotte (Oak Ridge National Lab.). [1961]. 30p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review of nuclear and chemical properties of sulfur, a discussion of problems of dissolution of a sample and counting techniques, and a collection of radiochemical procedures for sulfur as found in the literature are presented. (M.C.G.)

10050 (TID-14969) PRIMARY PROCESSES IN RADIATION CHEMISTRY. Progress Report [for] period February 15, 1961 to February 14, 1962. Edwin W. Abrahamson (Case Inst. of Tech., Cleveland). Contract AT(11-1)-909. 32p.

Progress is reported on the development of a flash x-ray system for investigating primary processes in the high-energy radiolysis of condensed systems. A study of the primary processes in photochemistry was initiated to establish the dependence of the photochemical activity in quinones on the excited electronic states. An appendix includes the results of a study of the population and decay of triplet states in polyenes. (B.O.G.)

10051 (TID-15003) STUDIES IN NUCLEAR CHEMISTRY. Progress Report [for 1961-1962]. (Johns Hopkins Univ., Baltimore). Feb. 1962. Contract AT(30-1)-1396. 5p.

The deuteron bombardment of benzene was investigated and the products of N^{13} (resulting from the $C^{12}(d,n)N^{13}$ reaction) and benzene were identified. The electron spin resonance spectrum of $C^{14}H_3OH$ was measured. An investigation was made of the free radicals resulting in

CH_3OH from various radiations. When boron hydrides such as pentaborane were investigated with ionizing radiation such as protons, higher hydrides were formed. These were investigated using mass spectroscopy. (M.C.G.)

10052 (TID-15072) GAMMA RAY INDUCED DECOMPOSITION OF ORANGE IV IN AQUEOUS AND ALCOHOLIC SOLUTIONS. Allen A. Denio, Jay H. Worrell, and Alexander R. Amell (New Hampshire. Univ., Durham). [1961]. Contract [AT(30-1)-1911]. 22p.

The effect of Co^{60} gamma radiation upon aqueous and alcoholic solutions of the monoazo dye Orange IV was studied. In methanol, the free radicals formed in the radiolysis reduce the azo linkage of the dye. The initial yield for the decolorization was determined: G(–Dye) = 2.7. The products of the azo reduction, as identified by their ultraviolet absorption spectra, are the sodium salt of sulfanilic acid and p-aminodiphenylamine and their derivatives. In aqueous solutions, there was no evidence of the products in the absorption spectrum of the decolorized solutions. Mechanisms for the reactions are proposed. (auth)

10053 SEPARATION OF THE EFFECTS OF FAST NEUTRONS AND GAMMA RADIATION ON THE RADIOLYSIS OF WATER. P. Bebesel and I. Purica (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 557-62 (1961). (In Rumanian)

The effects of fast neutrons and of gamma radiation on the radiolytic processes of the water in a heterogeneous reactor are separated by studying the water decomposition in the various vertical channels of the reactor. (tr-auth)

10054 SELF-ATTENUATION OF β RADIATION IN THICK RADIOACTIVE SOURCES. Pierre Lerch and A. Vogel-Ludin (Université and Hôpital Cantonal Universitaire, Lausanne, [Switzerland]). Chimia (Switz.), 15: 522-4(Nov. 15, 1961). (In French)

In measuring thick β-activity sources, one has to take in account the phenomenon of self-absorption in the source. It is shown that if the choice of the distance between source and counter on one hand, and of the chemical nature of the support on the other hand, are well chosen, it is possible to find a self-absorption correction curve that is exponential. The values of the necessary parameters are given for three radioisotopes of different β energies: phosphorus-32, calcium-45, and carbon-14. (auth)

10055 A RAPID METHOD FOR THE DETERMINATION OF TRITIUM, RADIOCARBON, AND RADIOSULFUR IN ANY ORGANIC SAMPLES BY MEANS OF LIQUID SCINTILLATION COUNTERS. F. Kalberer and J. Rutschmann (SANDOZ, Basel). Helv. Chim. Acta, 44: 1956-66(1961). (In German)

A detailed description is given of the determination of H^3, C^{14}, and S^{35} in any material by the oxygen flask method followed by liquid scintillation counting. Improved apparatus and simplified sample preparation enable the anslyses to be carried out quickly. For all determinations of C^{14} and S^{35} only one absorption solution is used. The use of an internal standard is no longer necessary, as the counting efficiency for all samples of the same isotope is constant under standard conditions. The accuracy and reproducibility are at least as good as those for other analysis methods. Safety measures are indicated. (auth)

10056 THE RADIATION CHEMISTRY OF HYDROCARBONS. IV. TOLUENE. Juerg Hoigné and Tino Gaeumann (Eidgenössische Technische Hochschule, Zurich). Helv. Chim. Acta, 44: 2141-50(1961). (In German)

The behavior of toluene and its mixtures with iodine under the influence of ionizing radiation is examined. All the more important dimers are identified and a kinetic process for their formation is proposed in comparison with analogous reactions of thermally produced radicals. (auth)

10057 ABSOLUTE METHOD FOR MEASURING β RADIOACTIVITY OF FLUIDS. V. V. Bazhenov and V. V. Bochkarev. Izmeritel'naya Tekh., No. 1, 55-7(Jan. 1962). (In Russian)

Measurements on β-active fluids by means of complete evaporation into a container followed by absolute measurements of the vapor are described. The method boasts a high order of accuracy and speed. The time of one measurement, including sample preparation, is one hour. (R.V.J.)

10058 ENERGY DISTRIBUTION AND FRAGMENTATION PROCESSES RESULTING FROM ELECTRON IMPACT ON PROPANE AND N-BUTANE. William A. Chupka and Manfred Kaminsky (Argonne National Lab., Ill.). J. Chem. Phys., 35: 1991-8(Dec. 1961).

The internal energy distribution was determined for propane and n-butane ions produced by electron impact. The method involves the use of differential ionization efficiency curves and depends on the validity of the linear threshold law for simple ionization. The experimental distributions are in fair agreement with theoretical calculations of Lennard-Jones and Hall and indicate that the major fraction of the parent ions are formed by simple removal of a valence electron. Only a minor fraction of the parent ions are apparently formed by removal of one valence electron together with excitation of one or more remaining electrons. Breakdown curves for propane and n-butane were determined experimentally and, except for the energy scales, are in fair qualitative agreement with the predictions of the statistical theory of mass spectra. The discrepancy between theoretical and experimental energy scales is ascribed at least in part to inadequacy of the theoretical rate equations used in the statistical theory. There is no evidence for gross failure of the assumptions of the theory regarding energy randomization although the number of crossings of potential surfaces of the molecular ion is shown to be very much smaller than originally assumed by others. (auth)

10059 ELECTRON SPIN RESONANCE STUDIES OF GAMMA-IRRADIATED SINGLE CRYSTALS OF SUCROSE. Hisashi Ueda, Zen'ichiro Kuri, and Shoji Shida (Japanese Association for Radiation Research on Polymers, Tokyo). J. Chem. Phys., 35: 2145-7(Dec. 1961).

The electron spin resonance of gamma-irradiated single crystals of sucrose was measured at 9400 mc/sec for various orientations in the magnetic field. The variations of the resonance with angle were greatest for rotation of the crystal about its b axis, which was kept perpendicular to the magnetic field. The anisotropic hyperfine structure was observed to vanish when the magnetic field is applied perpendicular to the (b,c) plane. It was ascertained that the radical formed is the type $X-\dot{C}H-Y$, which was previously proposed by others from the data obtained from the polycrystalline samples. (auth)

10060 ELECTRON SPIN RESONANCE STUDY OF RADIATION DAMAGE IN SINGLE CRYSTALS OF UREA COMPOUNDS. Thadho S. Jaseja and Roy S. Anderson (Univ. of Maryland, College Park). J. Chem. Phys., 35: 2192-7 (Dec. 1961).

Single crystals of urea compounds were examined by 3-cm electron spin resonance techniques after x and γ irradiation. All experiments were conducted at room tem-

perature. No resonances were observed in urea and thiourea. This is interpreted to indicate that the lifetimes of any resulting unstable species must be less than 30 min at room temperature. However, methylurea and ethylurea showed strong, highly stable spectra centered at $g \simeq 2.00$. Analyses of these spectra suggest that the trapped radicals are formed from methylurea and ethylurea, respectively, by the loss of a hydrogen atom. In both cases all radicals in the unit cell were considered to be magnetically equivalent. Calculated hyperfine intervals agree favorably with those observed. The spin density of the unpaired electron at the adjacent N–H group is believed less than 0.002, since the only apparent effect of this group was a broadening of the hyperfine lines. In methylurea the $\cdot C-H_2$ group was found to have an H–C–H angle of 117°. The principal components of the diagonal electron-nuclear coupling dyadic were 10, 22, and 32 gauss. In ethylurea the $\cdot C-H$ bond was observed to lie along a crystallographic axis. The principal components were 10, 21, and 24 gauss. In this case the isotropic coupling constant was 18 gauss. (auth)

10061 REACTIONS OF HIGH-ENERGY, EXCITED I^{128} IONS WITH GASEOUS MOLECULES. Edward P. Rack and Adon A. Gordus (Univ. of Michigan, Ann Arbor). J. Chem. Phys., 36: 287-91(Jan. 15, 1962).

The manner in which molecular additives inhibit the reaction of (n,γ) activated I^{128} with CH_4 was determined in an effort to observe indirectly reactions of I^{128} with the additives. The data suggest that O_2, N_2, and CF_4 serve only to remove excess I^{128} kinetic energy; the ionization potential of O_2 is greater than 12.16 ev, the potential energy of $I^+(^1D_2)$; the ionization potential of C_2F_6 is less than 12.16 ev; and CH_3I, CF_3I, n-C_3H_7I, and C_6H_6 inhibit the reaction principally as a result of I^++ additive ion-molecule reactions and/or physical quenching. (auth)

10062 IONIZATION AND FRAGMENTATION OF SOME MOLECULES BY HIGH-ENERGY ELECTRONS. P. Kebarle and E. W. Godbole (Univ. of Alberta, Edmonton). J. Chem. Phys., 36: 302-5(Jan. 15, 1962).

The mass spectra of some 10 representative organic compounds were obtained by using electrons with an energy up to 12 kev. Modifications of the ion source were made to reduce field penetration by the filament potential and emission of secondary electrons in the ion box. The mass spectra showed some small changes from 50 to 1000 ev. The changes were due to decreases in the abundance of ions of low relative intensity. These were ions which could be produced only by a succession of fragmentation processes. The mass spectra remained remarkably constant with further increase of the voltage. The significance of the results for gas phase radiolysis by α particles and β rays is briefly considered. (auth)

10063 ABSOLUTE RATE CONSTANT FOR THE REACTION OF HYDROXYL RADICALS WITH BENZENE IN WATER. Leon M. Dorfman, R. E. Buehler, and I. A. Taub (Argonne National Lab., Ill.). J. Chem. Phys., 36: 549-50(Jan. 15, 1962).

The absolute rate constant for the reaction of hydroxyl radicals with benzene was determined using fast reaction techniques in a pulse radiolysis study of the benzene–water system. By synchronized flash absorption spectroscopy of pulse-irradiated aqueous benzene solutions, a transient spectrum having a broad UV absorption with a strong maximum at 313 mμ was observed. By fast photoelectric recording of the transient absorption at 313 mμ, after a 0.4 μsec pulse of 15 Mev electrons at an average current of 60 ma, the rate of formation of the radical in the fast reaction OH + C_6H_6 = radical was observed. Data were obtained at benzene concentrations of 1×10^{-4} and 2×10^{-4} M, and at an initial $[OH]_0 < 5 \times 10^{-6}$ M. The rate constant obtained is $k_1 = 4.3 \pm 0.9 \times 10^9$ M^{-1} sec^{-1} at 23°C. It was concluded that the reaction consists of OH addition to form the hydroxycyclohexadienyl radical, to which the transient spectrum is to be assigned. (P.C.H.)

10064 DECOMPOSITION OF EXCITED ALKYL RADICALS IN THE LIQUID PHASE. Edward K. C. Lee and F. S. Rowland (Univ. of Kansas, Lawrence). J. Chem. Phys., 36: 554-5(Jan. 15, 1962).

Reaction sequences are given for the formation and decomposition or stabilization of alkyl radicals by recoil tritium atoms in trans-butene-2 and trans-hexene-2. Recoil tritium atoms were added to olefins by the neutron irradiation of capillaries containing powdered LiF and the liquid olefin. In addition to HT and to radioactive molecules, others were found corresponding to those expected from direct substitution of T for R at saturated carbon positions. The total yield of radioactive dimer was much less than that of the saturated analog of the parent compound. (P.C.H.)

10065 ELECTRON SPIN RESONANCE IN A GAMMA-IRRADIATED SINGLE CRYSTAL OF DIGLYCOLIC ACID MONOHYDRATE. Yukio Kurita (Duke Univ., Durham, N. C.). J. Chem. Phys., 36: 560-1(Jan. 15, 1962).

Single crystals of diglycolic acid monohydrate, $HOOC-CH_2-O-CH_2-COOH \cdot H_2O$, were grown from water and irradiated with γ rays. The crystal is monoclinic with $a:b:c = 1.324:1:0.463$ and $\beta = 90°$. The ESR of irradiated single crystals were measured at 9.04 kMc. The spectra were found to bear a striking resemblance to those of irradiated thiodiglycolic acid and indicate that similar free radicals are produced. (P.C.H.)

10066 CHANGE OF THE DEGREE OF POLYMERIZATION INDUCED BY NEUTRON IRRADIATION IN VARIOUS CONDENSED PHOSPHATES. M. Shima and S. Utsumi (Ochanomizu Univ., Tokyo). J. Inorg. & Nuclear Chem., 20: 177-84(Dec. 1961).

Powdered crystals of several kinds of chain and ring phosphates were irradiated at thermal neutron flux 5×10^{11} neutrons cm^{-2} sec^{-1} for 6 hr. The irradiated samples were analyzed using the combined techniques of refined paper chromatographic separation and radiochemical analysis. It was established that both degraded and polymerized products were always formed at tracer concentrations, though not detectable by ordinary chemical analysis. The degree of polymerization undoubtedly changed through hot atom reactions. The behavior of various species of phosphates and irradiated products was discussed. (auth)

10067 RAPID AND EFFICIENT PURIFICATION OF AMERICIUM. T. K. Keenan (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem., 20: 185-8(Dec. 1961).

About 200 mg of Am^{241} was brought to >99.8 per cent chemical purity by simple ion exchange and precipitation operations. Both dilute and concentrated ammonium thiocyanate solutions were used as eluting agents in conjunction with cation and anion exchangers to achieve this purity. The thiocyanate-resin system was not effective in purifying Cm^{244}. Even at comparable levels of total α activity, much more thiocyanate decomposition was observed with curium than with americium. The specific activity or density of α radiation is postulated as the controlling factor. (auth)

10068 RADIATION CHEMISTRY OF POLYETHYLENE. V. HYDROGEN ISOTOPE EXCHANGE STUDIES. Malcolm

Dole and Francis Cracco (Northwestern Univ., Evanston, Ill.). J. Phys. Chem., 66: 193-201(Feb. 1962).

After irradiation in vacuo with Co^{60} γ rays at liquid nitrogen temperature, Marlex-50 polyethylene was exposed to deuterium gas at room temperature. Considerable D–H exchange occurred, and the exchange was studied as a function of deuterium pressure, exchange cell volume, irradiation dose, and time of initiating the exchange after irradiation. Kinetic equations were derived for three cases: constant free radical concentration, first-order free radical decay, and second-order free radical decay. The data agree best with the first-order decay equations; the decay constant and duration of exchange agree to an order of magnitude with estimates from the previous ESR work of others. The D_2-free radical reaction rate constant is about 1000-fold faster than calculated for a gas phase reaction between D_2 and $R\dot{C}HR'$, but close to that for the D_2 and $CH_3\dot{C}H_2$ reaction. The exchange, as expected, does not continue until isotopic exchange equilibrium has been established. The total observable number of D–H exchanges was estimated to be between 1 and 2-fold the number of free radical sites initially present. For reasons given, the exchange probably involves hydrogen atoms close to the free radical or on the nearest neighbor sites, and provides a new mechanism for free radical migration in the solid polyethylene. (auth)

10069 THEORY OF RADIATION CHEMISTRY. V. GENERALIZED SPUR DIFFUSION MODEL. Aryeh H. Samuel (Stanford Research Inst., Menlo Park, Calif.). J. Phys. Chem., 66: 242-5(Feb. 1962).

The sharp-boundary model of Magee for diffusion and recombination of radicals and ions produced by ionizing radiation is extended to the case of a spherically symmetrical spur. Sample calculations and asymptotic solutions for the high- and low-background regimes are also included; the importance of the transition region between these is emphasized. (auth)

10070 A DETERMINATION OF SOME RATE CONSTANTS FOR THE RADICAL PROCESSES IN THE RADIATION CHEMISTRY OF WATER. Harold A. Schwarz (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 66: 255-62(Feb. 1962).

The steady-state concentrations of H_2O_2 and O_2 produced by a 1.5 Mev electron beam in pure water were investigated. Both steady states increase with the square root of the intensity, I. The ratio $(O_2)/(H_2O_2)$ is 0.86; $(H_2O_2)^2/I = 2.4 \times 10^{-16}$ M^2 sec/rad. It is shown that a general mechanism including any number of radical combination reactions and radical-product reactions predicts a square root intensity dependence for all products. The results are interpreted in terms of a mechanism including the following reactions: $OH + H_2O_2 \rightarrow H_2O + HO_2$, $H + H_2O_2 \rightarrow H_2O + OH$, $OH + HO_2 \rightarrow H_2O + O_2$, $OH + OH \rightarrow H_2O_2$, and $H + HO_2 \rightarrow H_2O_2$. k_8/k_2^2 is found to be 1.9×10^{-6} M sec, and k_7k_9/k_2k_8 is found to be 74. The electron beam then was pulsed and the H_2O_2 steady state followed as a function of the pulse rate. The resulting curve is interpreted in terms of the lifetime of the OH radical, giving $k_2 = 4.5 \times 10^7$ M^{-1} sec^{-1} and $k_8 = 4 \times 10^9$ M^{-1} sec^{-1}. (auth)

10071 THE REDUCING RADICALS PRODUCED IN WATER RADIOLYSIS: SOLUTIONS OF OXYGEN–HYDROGEN PEROXIDE–HYDROGEN ION. Gideon Czapski and A. O. Allen (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 66: 262-6(Feb. 1962). (BNL-5576)

The reducing radical H or H_2O^- arising from the γ radiolysis of water is shown to react competitively with dissolved O_2 and H_2O_2; the ratio of the respective rate constants is 2.0. It also reacts in a simple competitive bimolecular fashion with hydrogen ion, H^+, to give an acid form of the radical which reacts several thousand times as fast with O_2 as with H_2O_2. The rate constants for reaction of H with O_2 and with H^+ are equal. The yield of H deduced from the $O_2-H_2O_2$ competition in neutral solution is 2.85, which is equal to the standard value of the total yield of reducing radicals. Thus essentially none of the reducing radicals appear to be generated initially in the acid form, a conclusion which disagrees with recently proposed interpretations of some other radiolytic reactions. (auth)

10072 RADIOLYTIC AND PHOTOCHEMICAL DECOMPOSITION AND EXCHANGE IN LIQUID AND GASEOUS CCl_3Br. Austin H. Young and John E. Willard (Univ. of Wisconsin, Madison). J. Phys. Chem., 66: 271-5(Feb. 1962).

The radiolysis of liquid and gaseous CCl_3Br, photolysis of gaseous CCl_3Br, and the radioinduced exchange of bromine between Br_2 and CCl_3Br in the liquid and the gaseous phases were studied. Co^{60} γ rays and 2537 Å light were the activating radiations. Typical product yields in units of molecules/100 ev absorbed are reported. The apparent activation energies for the formation of the products are about 3 kcal/mole, which is lower than required for thermal radical and atom abstraction reactions in this system. This may result from a small contribution from thermal processes superimposed on a major contribution from temperature insensitive reactions of vibrationally excited species or ions. The reaction cross sections for these hot processes must be significantly lower than the collision cross sections since the yields are reduced by 1 mole % added Br_2. The G-values for the exchange caused by γ rays in the gas and in the liquid at 108° are both of the order of 600 atoms/100 ev absorbed while that in the liquid at 20° is about 150. These values indicate chain reactions with an over-all activation energy which appears to be too low to be explained on the basis of the known thermal chemistry of the system, and so may include a contribution from ion molecule reactions. G(exchange) is sensitive to some unknown variable but is not affected significantly by 2 mole % O_2 in the presence of 1 mole % Br_2. (auth)

10073 RECOIL REACTIONS WITH HIGH INTENSITY SLOW NEUTRON SOURCES. IV. THE RADIOLYSIS OF CRYSTALLINE ALKALI METAL BROMATES WITH γ-RAYS. G. E. Boyd, E. W. Graham, and Q. V. Larson (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 66: 300-7(Feb. 1962).

The radiolysis of the alkali metal bromates by Co^{60} γ rays was effected to decompositions greater than three mole %. The amounts of bromate ion decomposed increased linearly with dose at first, but subsequently the dependence became non-linear for all salts except $LiBrO_3$. The initial 100 ev radiolytic yields or G_0 values for bromate decomposition were: 0.31, 1.46, 1.71, 2.33, 3.4, and 5.1 for $LiBrO_3$, $NaBrO_3$, $KBrO_3$, $RbBrO_3$, $CsBrO_3$, and $TlBrO_3$, respectively. The yields increased only slightly with temperature between –195 and 85°, and for $CsBrO_3$ were almost independent of the dose rate from 8.8×10^{14} to 7.6×10^{16} ev g^{-1} sec^{-1}. The radiolysis of bromate ion gave bromite, hypobromite, bromide, and oxygen gas in amounts which varied with the alkali metal cation in the salt and with the total dose absorbed. Virtually all the oxidizing fragments produced in the crystalline salts by irradiation could be removed by thermal annealing. The radiolytic yields for bromate decomposition could not be correlated either with

the thermodynamic stability of the salts or with their isothermal decomposition rates observed in the absence of radiation. However, an exponential dependence of G_0 on the crystal free space was found, and a mechanism for the decomposition of the molecular bromate ion could be proposed. (auth)

10074 THE RADIOLYSIS OF ETHYLENE: DETAILS OF THE FORMATION OF DECOMPOSITION PRODUCTS. Myron C. Sauer, Jr. and Leon M. Dorfman (Argonne National Lab., Ill.). J. Phys. Chem., 66: 322-5(Feb. 1962).

The radiolysis of ethylene was studied with emphasis on the decomposition products. The G-values of hydrogen and acetylene are independent of ethylene pressure from 150 to 1000 mm, being 1.2 and 2.4, respectively, but increase significantly below this pressure. Isotopic and scavenger data for the system $C_2H_4-C_2D_4$ are presented. The bearing of the experimental data on the relative importance of ionic and excited states in the formation of hydrogen and acetylene is discussed. (auth)

10075 LOW ENERGY ELECTRON IRRADIATION OF METHANE. Russell R. Williams, Jr. (Haverford Coll., Penna.). J. Phys. Chem., 66: 372-3(Feb. 1962).

The composition of the condensable products of low-energy electron irradiation of methane was examined as a function of electron energy and other conditions. Practically no variation was found in product composition over the range 700 to 1300 v. Other variables were also explored. It was also established that no significant amounts of ethylene or acetylene were produced in these experiments. A lack of significant variations in product composition with electron energy, as determined by the applied voltage, indicates that a single primary process probably is responsible for the whole spectrum of products observed. The product spectrum obtained was compared with that observed in conventional radiolysis of methane, and considerable correspondence was obtained. This suggests that the effect of high energy electrons may involve, in large part, excitation rather than ionization. (P.C.H.)

10076 PROPORTIONAL FLOW DETECTOR FOR CAPILLARY RADIOCHROMATOGRAPHY. A. Yu. Aleksandrov and M. I. Yanovskii (Inst. of Chemical Physics, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 794-800(Sept.-Oct. 1961). (In Russian)

The use of capillary radiochromatographic analysis with proportional and microionization detectors in investigating the kinetics of chemical reactions using labeled compounds is described. The construction of relatively high sensitivity 0.3 to 0.05 ml flow counters with stable counting characteristics is also described. (R.V.J.)

10077 HIGH-PRESSURE POLYMERIZATION INDUCED BY GAMMA RADIATION. Nuclear Energy, 68-9(Feb. 1962).

The method and equipment used for preparing polymers from normally non-polymerizing monomers by exposing the monomers to gamma radiation under high pressure are described. The reaction is initiated by the radiation and favored by pressure. For the study, degassed liquid monomers were distilled under vacuum to a detachable pressure bomb and compressed under high pressure (10000 to 15000 atm) before exposure to gamma radiation. The method is illustrated by studies made with perfluoroheptene, carbon disulfide, and alpha-methylstyrene. (N.W.R.)

10078 HIGH-PRESSURE AND -TEMPERATURE RADIATION CHEMISTRY RESEARCH. Ernest J. Henley (Stevens Inst. of Tech., Hoboken, N. J.) and William H. Cropper. Nucleonics, 20: No. 3, 96; 98-100(Mar. 1962).

A review is given of research being conducted in high-pressure and -temperature radiation chemistry. Thus, a brief review is given of the research being conducted on hydrocarbon cracking, alkylation, decomposition of polyphenyl compounds, oxidation of hydrocarbons, polymerization of ethylene, heterogeneous reactions, and inorganic reactions (including nitrogen fixation). The bibliography contains 49 references. (N.W.R.)

10079 THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. I. THE EFFECT OF CHANGING LINEAR ENERGY TRANSFER ALONG A POLONIUM α-PARTICLE TRACK. E. Collinson, F. S. Dainton, and J. Kroh (The University, Leeds, Eng.). Proc. Roy. Soc. (London), A265: 407-21(Feb. 6, 1962).

Absolute G values for chemical change when various aqueous solutions are irradiated with α-particles from an external polonium source were determined for different fractions (x) of the α particle track spent within the solution. $G(Fe^{3+})$ for an aerated solution containing 1 m$\underline{M}$ ferrous ions and 0.1 $\underline{N}$ sulfuric acid decreases from 5.0 at $x = 0.02$ through a minimum value 3.65 at $x = 0.11 \times 0.01$ and then increases to 5.94 at $x = 0.525$. The local value $G(Fe^{3+})$, defined as $G(Fe^{3+})$ for an element of track length a distance xR from the end of the track, where R is the range of the whole track in water, shows a similar but more pronounced dependence on x which is strongly reminiscent of the inverted Bragg curve for l.e.t. plotted against x in this medium, having a minimum of 3.2 ± 0.1 at $x = 0.08 \pm 0.01$. As x is increased $G(Ce^{3+})$ for an aerated 200 $\mu\underline{M}$ solution of ceric sulfate in 0.1$\underline{N}$ sulfuric acid shows no minimum but increases from 1.0 at $x = 0.04$ to 3.0 at $x = 0.25$ and 4.05 at $x = 0.525$. Thallous ions have no effect on $G(Ce^{3+})$ for $x \leq 0.45$. $G(H_2O_2)$ for aerated water was found to be 1.22 ± 0.06. It is concluded that very few hydroxyl radicals are available and that the intra-track reactions between H_2O_2 and H as well as OH are very important and vary in extent as x is varied. (auth)

10080 THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. II. RADICAL AND MOLECULAR YIELDS FOR TRITIUM β-PARTICLES. E. Collinson, F. S. Dainton, and J. Kroh (The University, Leeds, Eng.). Proc. Roy. Soc. (London), A265: 422-9(Feb. 6, 1962).

Assuming $G(Fe^{3+}) = 12.7$ for aerated, acidified ferrous sulfate solutions, the following values were measured: $G(O_2)^{Fe^{3+},Cu^{2+}} = 0$, $G(H_2)^{Fe^{3+},Cu^{2+}} = 0.51 \pm 0.03$, $G(Fe^{3+})^{Cu^{2+}} = 1.06 \pm 0.03$ for the ferrous-cupric system; $G(Ce^{3+}) = 2.84 \pm 0.05$ for acidified solutions of ceric sulfate; $G(Ce^{3+})^{Tl^+} = 7.30 \pm 0.025$ for the ceric-thallous system; $G(H_2O_2)_i = 1.03 \pm 0.06$ for aerated 0.1$\underline{N}$ sulfuric acid; and $G(H_2) = 0.935 \pm 0.09$ for 0.1$\underline{N}$ sulfuric acid and 0.607 ± 0.06 when 4×10^{-5} $\underline{M}$ H_2O_2 is also present. The equation $G(Fe^{3+})^{\beta+\gamma} = 12.7x + 15.5(1 - x)$, where x is the fraction of the total energy absorbed provided by β particles, is valid for $x = 0$ to 1. The following quantities are deduced: $G_H = 2.91 \pm 0.01$, $G_{H_2O_2} = 0.97 \pm 0.02$, $G_{OH} = 2.00 \pm 0.08$, $G_{H_2} = 0.53 \pm 0.05_5$, and $G_{-H_2O} = 3.97 \pm 0.12$. The predicted value for $G(Fe^{3+})^{-O_2} = 6.87 \pm 0.13$ is not attained unless $[Fe^{3+}] \geq 10^{-3}\underline{M}$ and $[H_2SO_4] \geq 0.8\underline{N}$. These results are discussed and it is concluded that, contrary to earlier views, the primary process in T β irradiation is closer to that of Co^{60} γ rays than that of α particles. (auth)

10081 THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. III. THE ISOTOPE EFFECT FOR POLONIUM α-PARTICLES AND TRITIUM β-PARTICLES. E. Collinson, F. S. Dainton, and J. Kroh (The University, Leeds, Eng.). Proc. Roy. Soc. (London), A265: 430-5 (Feb. 6, 1962).

Investigations were made on the radiolysis of D_2O. For tritium β particles the derived yields are $G_D = 3.34 \pm 0.03$, $G_{OD} = 2.26 \pm 0.1$, $G_{D_2O_2} = 0.81_5 \pm 0.02$, $G_{D_2} = 0.27_5 \pm 0.08_5$, and $G_{-D_2O} = 3.89 \pm 0.14$. Observed yields $G(Ce^{3+})^{Tl^+} = 7.50 \pm 0.5$, $G(Fe^{3+})^{-O_2} = 7.15 \pm 0.15$, $G(D_2)^{0.1N} = 0.61 \pm 0.02$, and $G(D_2O_2)_i^{O_2} = 1.02 \pm 0.1$ are close to expected values. For polonium α particles of 3.0 and 1.6 Mev energy respectively the yields are $G(Fe^{3+}) = 6.20$ and 4.27, $G(Ce^{3+}) = 3.20$ and 2.68, $G(Ce^{3+})^{Tl^+} = 3.50$ and 2.85, and hence $G_D + G_{DO_2} = 1.35$ and 0.71, $G_{OD} = 0.15$ and 0.085, $G_{D_2O_2} = 1.0$ and 1.03; $G(D_2O_2)^{O_2}$ for 1.6 Mev α particles is 1.24. The isotope effect thus extends up to the highest accessible l.e.t. and in fact increases slightly, which is to be expected if it is caused by a more widespread distribution of D as compared with H atoms. Striking confirmation of the more widespread distribution of D is afforded by the fact that in deaerated tritiated solutions almost 100% of the available D atoms react with ferrous ion under conditions where only 60% of the available H atoms react. (auth)

10082 PHASE AND ISOTOPE EFFECTS IN SECONDARY REACTIONS OF BROMINE RECOIL ATOMS IN BROMOMETHANE DERIVATIVES. An. N. Nesmeyanov and E. S. Filatov. Radiokhimiya, 3: 601-9(1961). (In Russian)

The mechanism of inelastic recoil atom reactions with liquid and solid phase CCl_3Br, CCl_2Br_2, $CHBr_3$, $CHFBr_2$, CH_2BrNO_2, and CBr_3NO_2 in the epithermal region was studied. It is shown that an isotopic effect, expressed by variable retention of Br^{82} and Br^{80m}, takes place in all liquid bromomethane reactions with a strange halogen atom. The isotopic effects are produced by the high-energy reactions of recoil atoms with molecules of the original compound. (R.V.J.)

10083 CHEMICAL EFFECTS OF Br^{82} RECOIL ATOMS FOLLOWING (n,γ) REACTION ON VARIOUS BENZENE DERIVATIVES. An. N. Nesmeyanov, E. S. Filatov, and A. Mansfel'd. Radiokhimiya, 3: 610-13(1961). (In Russian)

The replacement of single-atom benzene derivatives in Br^{82} recoil atom is subordinate to a simple function of mass ratio. The yields of bromobenzene in neutron irradiations of bromoethylene in toluene and ethylbenzene are found. (R.V.J.)

10084 CHEMICAL EFFECTS OF Br^{82} AND Hg^{203} RECOIL ATOMS PRODUCED BY $Br^{81}(n,\gamma)Br^{82}$ AND $Hg^{202}(n,\gamma)Hg^{203}$ REACTIONS ON BENZENE. An. N. Nesmeyanov and E. S. Filatov. Radiokhimiya, 3: 614-22(1961). (In Russian)

The yields of various products containing Br^{82} in neutron irradiations of $C_2H_2Br-C_6H_6$ solutions were determined in relation to the quantitative composition of the mixture. The yields of hydrogen replacement products in benzene from Hg^{203} and Br^{82} recoil atoms following (n,γ) reactions in benzene-$HgBr_2$ solutions were also determined. The mechanism of hydrogen replacement in recoil atom reactions was analyzed in order to clarify published data. (R.V.J.)

10085 CONSTANT Tl^{206} SOURCE WITHOUT A CARRIER. V. D. Nefedov and O. V. Larionov. Radiokhimiya, 3: 639(1961). (In Russian)

A constant source of Tl^{206} without a carrier was developed by introducing Bi^{210} into $(C_6H_5)_3Bi$ or $(C_6H_5)_3BiCl_2$. The $(C_6H_5)_3BiCl_2$ is more stable. The decay curve of $(C_6H_5)_3Bi^*$ is included. (R.V.J.)

10086 RADIOLYSIS OF ANTIMONY(III) IN AQUEOUS SOLUTION. Niro Matsuura, Yoshimi Kurimura, and Masao Takizawa. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: 224-32(Dec. 1961). (In English)

It was observed that Sb(III) in 0.8 N H_2SO_4 and 0.8 N HCl is oxidized to Sb(V) by Co^{60} γ rays. In aerated system, G(–Sb(III)) value in H_2SO_4 medium was between 1.5 and 3.4 depending on Sb(III) concentration. G(–Sb(III)) value in HCl medium was 3.4 independent of Sb(III) concentration; after-effect was found only in this case. In nitrogen-saturated system, G(–Sb(III)) value was 0.43 in H_2SO_4 and 0.36 in HCl media. A mechanism of induced oxidation of Sb(III) is suggested. (auth)

10087 RADIOLYSIS OF METHANOL VAPOUR. J. H. Baxendale and R. D. Sedgwick (The University, Manchester, Eng.). Trans. Faraday Soc., 57: 2157-66(Dec. 1961).

The yields of hydrogen, formaldehyde, ethylene glycol, methane, and carbon monoxide from the radiolysis of methanol vapor were measured and also those of H_2 and HD from CH_3OD. These were correlated with the ions observed in the mass spectra. Benzene decreases the yields of hydrogen and formaldehyde and the effect is attributed partly to the scavenging of hydrogen atoms and partly to deactivation of an excited state of methanol which is produced by ion neutralization. The yields from the xenon-sensitized radiolysis of methanol are reasonably consistent with the assumption of charge transfer from Xe^+ to methanol. (auth)

10088 PROSPECTIVE DEVELOPMENT OF NUCLEAR CHEMISTRY. V. I. Gol'danskii. Vestnik Akad. Nauk. S.S.S.R., 31: No. 11, 25-33(Nov. 1961). (In Russian)

The prospective developments in nuclear chemistry are reviewed and the problems in multichannel nuclear reactions and related problems in cosmic- and geochemistry are analyzed as well as the search for new isotopes, new elements, and other types of radioactivity. The nonconservation of parity and chemistry, chemical properties and fission probabilities, Mossbauer effect and molecule structure, and chemical results of nuclear transformations are also discussed. (R.V.J.)

10089 THE MODIFICATION OF THE CATALYTIC ACTIVITY OF COPPER BY α IRRADIATION. G.-M. Schwab (Universität, Munich), R. Sizmann, and N. Todo. Z. Naturforsch., 16a: 985-91(Oct. 1961). (In German)

The catalytic activity of copper for ethylene hydration was strongly inhibited by a dose of only 2×10^{12} 5.3-Mev α particles/cm^2. By heating for several hours at 250°C in hydrogen atmosphere, the catalyst could be completely regenerated. It was shown that the reaction velocity between adsorbed ethylene and hydrogen was affected principally by the irradiation, not by the adsorption capacity for ethylene. It was assumed that catalytic centers were disturbed by the displacement of surface atoms. (tr-auth)

10090 THE THERMAL DECOMPOSITION OF IRRADIATED POTASSIUM BROMATE. Joseph Jach (Picatinny Arsenal, Dover, N. J.). p.334-44 of "Reactivity of Solids. Proceedings of the Fourth International Symposium on the Reactivity of Solids, Amsterdam, 1960." J. H. de Boer, ed. Amsterdam, Elsevier Publishing Company. (BNL-4665) (In English)

The thermal decomposition of normal and gamma irradiated potassium bromate crystals of average diameter 0.3 mm was studied in the temperature range 342 to 412°C. The only reaction products are potassium bromide and oxygen. There is an initial rapid gas evolution representing 1–2% reaction which is eliminated on irradiation and grinding. No induction period was observed. p/t plots for Co^{60}

gamma irradiated material follow the equation $p = p_\infty (1 - e^{-kt})$ over the whole temperature range. Irradiation removes discontinuity from the Arrhenius plot. In addition the p/t curves are all superimposable on a reduced time scale plot. Thus, the form of the p/t curves and the activation energy are unique over the whole temperature and decomposition range. In contrast, the decomposition kinetics and activation energies of the unirradiated material both change over the temperature range studied so that the decomposition curves cannot be superimposed. The activation energy for the material irradiated to 9.5×10^7 and 6.2×10^8 r are 53 and 48 kc/m, respectively. Microscopic observation reveals that surface pre-melting plays an important role in the decomposition. The absence of an induction period and the inability of grinding or irradiation to markedly change the rate constants indicates that nucleation is rapid and complete at the beginning of the reaction. The observed irradiation effects are considered in terms of current ideas of irradiation damage. (auth)

10091 RADIATION-INDUCED DEFECTS AND THE CHEMICAL REACTIVITY OF SOLIDS. G. J. Dienes (Brookhaven National Lab., Upton, N. Y.). p.416-24 of "Reactivity of Solids. Proceedings of the Fourth International Symposium on the Reactivity of Solids, Amsterdam, 1960." J. H. de Boer, ed. Amsterdam, Elsevier Publishing Company. (BNL-4590) (In English)

Basic processes arising from the interaction of high energy radiation with solids are reviewed briefly with emphasis on some recent work in the following areas: production of simple lattice defects, namely displaced atoms and displaced electrons; and fission and thermal spikes. According to present evidence, the production of simple lattice defects is the dominant radiation effect in most non-fissionable solids. Displaced atoms exert an important influence on rate processes in a solid. The most important effects in this category are radiation enhanced nucleation, diffusion, and the breakup of ordered clusters by heavy-particle bombardment. Attention is given briefly to chemical effects of enhanced diffusion, for example enhanced oxidation of metals. Displaced atoms and electrons also influence the chemical activity of solids in heterogeneous solid-gas and solid-liquid reactions. The most pertinent examples of radioinduced catalytic activity, such as enhanced oxidation of graphite, enhanced hydrogen–deuterium exchange, and ortho-para hydrogen conversion over irradiated oxides, are reviewed. It is pointed out that, while radiation enhanced catalysis has been demonstrated, correlation of altered chemical activity with radiation induced defects or changes in physical properties has not yet been achieved. Some results of gas adsorption experiments on irradiated aluminium oxide are also given. (auth)

10092 NEW PROCESS FOR THE PREPARATION OF NOVEL COPOLYMERS. (to Societe Anonyme Ethylene Plastique). British Patent 890,145. Feb. 28, 1962.

A process is given for producing polyethylene-base graft copolymer products. The process comprises activating inhibitor-free polyethylene by heating and/or irradiation and then subjecting the activated polyethylene to graft copolymerization conditions with a vinyl monomer. In the preferred embodiment of the invention, the polyethylene is heated from 60 to 105°C for 100 to 200 hr and exposed to 2×10^3 to 2×10^6 r of ionizing radiation, both treatments being carried out in oxygen at 0.2 to 20 atm. (D.L.C.)

Raw Materials and Feed Materials

10093 (BM-RI-5916) RECOVERY OF THORIUM FROM ORES IN COLORADO, IDAHO, AND MONTANA. S. R. Borrowman and J. B. Rosenbaum (Bureau of Mines. Salt Lake City Metallurgy Research Center). Dec. 1960. 40p.

An investigation was made of the extractive metallurgy of thorite ores. The work was done mainly on thorite ore containing 3.87% ThO_2 from the Powderhorn district of Colorado and on a composite sample containing 0.52% ThO_2 from the West Mountains district of Colorado. Limited tests of a corroborative nature were also made on a sample containing 2.30% ThO_2 from the Lemhi Pass area on the Idaho-Montana border. Procedures examined by batch and continuous bench-scale tests are described. It was concluded that domestic thorite ores of the type examined are amenable to treatment by an acid leach solvent extraction process. Over 90% of the Th is readily recoverable in a product containing about 99% ThO_2. (C.H.)

10094 (BM-RI-5917) RECOVERY OF THORIUM FROM A WYOMING ORE. S. R. Borrowman and J. B. Rosenbaum (Bureau of Mines. Salt Lake City Metallurgy Research Center). Jan. 1961. 11p.

An investigation of Bald Mountain, Wyo. ore was conducted in which it was found that the monazite concentrate prepared from this conglomerate can be decomposed by the conventional sulfuric acid-cure treatment. The resultant acid leach liquor can be processed by primary amine solvent extraction to yield a 99% ThO_2 product. (J.R.D.)

10095 IMPROVEMENTS IN OR RELATING TO PROCESSES FOR THE PRODUCTION OF URANIUM OXIDE. Allan Robert Gibson, Ronald George Avery, and Leonard Lewis Wassell (to United Kingdom Atomic Energy Authority). British Patent 889,307. Feb. 14, 1962.

A process is outlined for producing pure UO_2 from impure oxide, e.g., uranium ore concentrate. The process comprises the steps of preparing a suspension of the impure oxide in a melt of at least one alkali and/or alkaline earth metal chlorides, chlorinating the suspension in presence of carbon, converting UCl_4 to UO_2Cl_2 by contacting the melt with O_2, and selectively precipitating UO_2 by contacting the melt with H_2. The melt may be purified by electrolysis for recycling, and the precipitated UO_2 may be either removed as such or converted back into UO_2Cl_2 for electrolytic precipitation as UO_2 on a removable cathode. (D.L.C.)

Separation Processes

10096 (BM-RI-5941) SOLVENT EXTRACTION OF BERYLLIUM FROM SULFATE SOLUTIONS BY ALKYL-PHOSPHORIC ACIDS. R. O. Dannenberg, D. W. Bridges, and J. B. Rosenbaum (Bureau of Mines. Salt Lake City Metallurgy Research Center). June 1961. 18p.

Experiments with organophosphate solvent extraction of Be from sulfate leach liquors are described. A discussion of theoretical aspects is also included. The best over-all results were obtained by the use of di-(2-ethylhexyl) phosphoric acid (EHPA). In comparison with applications in U ore processing, organophosphates in Be technology appear poor, however in comparison with other Be processes this method appears to have merit because of its relative simplicity. (J.R.D.)

10097 (EURAEC-81) REPROCESSING OF SPENT FUELS. Progress Report No. 3, Fourth Quarter 1960. (Brussels. Centre d'Etude de l'Energie Nucleaire). 1960. Work performed under United States-Euratom Joint Research and Development Program. Contract [008-60-4-RDB]. 99p.

A systematic study was carried out on the chlorination of pulverized UO_2, by means of CCl_4, in the presence of various gases. Special efforts were made to obtain uranium tetrachloride and uranium oxychlorides. In order to im-

prove the de-contamination factors which can be obtained by chlorination, a study was made of the behavior of troublesome fission products in the presence of oxidizing, reducing, and chlorinating agents. Interesting data were drawn from this study. A study was made of the influence of recycling on the speed of oxidation of UO_2 and of the influence of recycling and partial hydrogen pressure on the speed of U_3O_8 reduction. A study was also made of the reduction speeds of the various $UO_{2+x}(O < x < 0.67)$ fractions obtained on fluidized bed. The data obtained will be used for the fluidization tests. The study of the cyclic oxidation-reduction of non-irradiated sintered UO_2 permitted the establishment of a general method of examination for the fuels with a UO_2 base (irradiated and non-irradiated). Calculations in connection with the β-γ regrowth of the activity of reprocessed uranium, were carried out in order to determine the decontamination factors to be attained during reprocessing. The results of the calculations and tests related to the preparation of a fissium intended for the decontamination studies are also given. Fundamental, theoretical and experimental studies on fluidization were carried out. The equipment for the production of UF_6 is nearing completion. UF_4 production tests are continuing. A better knowledge of the factors influencing the UF_4 output, was gained. This output was considerably increased. The gaseous phase chromatography tests were continued. The construction of a distillation column is nearing completion. The installation of the plutonium laboratory and the assembly of the apparatuses is continuing. (auth)

10098 (HW-68954(Rev.I)) RADIOLOGICAL DESIGN CRITERIA FOR THE FUEL RECYCLE PILOT PLANT. L. G. Faust and C. M. Unruh (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 31, 1961. Contract AT(45-1)-1350. 16p.

Radiological design criteria for the Fuel Recycle Pilot Plant were formalized to assist design engineers. These criteria were developed to assure adequate control of physical conditions relating to radiation exposures to personnel, contamination, and solid, liquid, and gaseous radioactive wastes. Site location, external dosimetry, internal depositions, building air control, radioactive material handling and storage, building traffic and control, radiation monitoring, radioactive waste disposal and control, automatic detection of malfunction, and radioactive material release limits are discussed. (M.C.G.)

10099 (IDO-14559) INTERIM REPORT ON THE DEVELOPMENT OF AN AIR PULSER FOR PULSE COLUMN APPLICATION. M. E. Weech, R. S. P'Pool, and D. K. MacQueen (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Sept. 22, 1961. Contract AT(10-1)-205. 32p.

The Idaho Chemical Processing Plant for several years has been studying various pulsing systems, used in extraction columns for processing irradiated nuclear fuel elements, in an effort to eliminate the mechanical difficulties in present pulsing systems. An air pulsing system has been demonstrated, and a discussion is given of experimental work, pulser design, and plant operational experience with this system. It is concluded, from work completed thus far that air pulsing of extraction columns is a considerable improvement over other systems. (auth)

10100 (IS-286) SEPARATION OF VARIOUS COMPONENTS FROM URANIUM BY OXIDATION-REDUCTION REACTIONS IN A LIQUID KCl-LiCl/ZINC SYSTEM. Premo Chiotti and Sidney J. S. Parry (Ames Lab., Ames, Iowa). Apr. 10, 1961. Contract W-7405-eng-82. 67p.

The separation of various components from U by oxidation-reduction reactions in a fused KCl-LiCl/Zn system was investigated. The transfer of solutes from the Zn to the salt phase on the stepwise addition of $ZnCl_2$ and subsequent transfer of solutes from the salt to the Zn on the stepwise addition of Mg were measured. Solutes investigated included Fe, Mo, Nb, Cr, Y, Zr, Th, U, Pa, and Ce. The objective was to obtain basic information which would be helpful in the design of a practical separation process for the purification of spent reactor fuels. The data show that the sequences in which the components investigated are oxidized and transferred to the salt phase on the addition of $ZnCl_2$ at 500°C is C, U with Y, Th, Pa, Zr, and Cr. Nb, Mo, and Fe are not oxidized and remain in the Zn. The inverse sequence results on reduction with Mg. Measurements were also carried out at 700°C. Experimental evidence for a valence of three for Th as chloride in the salt is presented. The data indicate that the valence of Zr is also three with increasing amounts of plus four present as the $ZnCl_2$ content of the salt is increased beyond 1.0 wt %. Activity coefficients for some of the solutes in Zn are presented. An attempt is made to correlate the data obtained with available thermodynamic data. (auth)

10101 (ORNL-3220(Pt.I)) DISSOLUTION OF BeO- AND Al_2O_3-BASE REACTOR FUEL ELEMENTS. PART I. K. S. Warren, L. M. Ferris, and A. H. Kibbey (Oak Ridge National Lab., Tenn.). Feb. 14, 1962. Contract W-7405-Eng-26. 24p.

Aqueous methods for recovering uranium from BeO- and Al_2O_3-base gas-cooled-reactor fuel elements are being evaluated. Two methods for processing Hastelloy-X-clad pelletized BeO-base fuels containing 60 to 70% UO_2, such as the GCRE and MGCR, seem feasible. One method involves mechanical stripping or chopping of the cladding followed by leaching of the uranium from the fuel pellets with boiling 6-13M HNO_3. In the other method the cladding and UO_2 are dissolved in boiling 2M HNO_3-4M HCl. In either case, most of the BeO matrix remains as an undissolved residue. Pellets containing 70% UO_2 dissolved completely in less than 20 hr in boiling 8M HNO_3 containing either 2M H_2SO_4 or 0.5M HF, producing solutions containing 4 g of uranium per liter. Fuels of high BeO content, e.g. BeO-5% UO_2, dissolved only slowly in boiling aqueous reagents. Highest initial rates were in sulfuric acid solutions, log (Rate, mg $min^{-1}cm^{-2}$) = 0.223 (H_2SO_4, M) - 2.81, and in HF-NH_4F solutions. In boiling 5-8M NH_4F the initial dissolution rate increased from 0.07 to 3.5 mg $min^{-1}cm^{-2}$ as the HF concentration increased from 0 to 20M. Leaching, with boiling 10M HNO_3, of uranium from UO_2-Al_2O_3 fuel pellets was studied briefly. In 4 hr leaching uranium recoveries from pellets containing 10-μ grains of UO_2 dispersed in an Al_2O_3 matrix decreased from 99.99 to 11.6% when the Al_2O_3 content of the pellets increased from 3.7 to 61.1%. The uranium concentration was 1.0M in the case of complete dissolution. (auth)

10102 (ORNL-TM-65) CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, AUGUST 1961. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Mar. 1, 1962. Contract [W-7405-eng-26]. 95p.

Engineering studies of a 6-in.-ID countercurrent foam column were started. The capacity of Mark II Stacked Clone Contactor was found to be limited by gradually increasing entrainment. Thoria sols were prepared from trough denitrator products in a conical bottom tank agitated by circulation through an external centrifugal pump. Experimental results agreed favorably with predicted results

for the reaction of CO with CuO and for the simultaneous reactions of H_2 and CO with CuO. In a 2-in. dissolver, Modified Zirflex dissolution rates of Zircaloy-2 increased non-linearly with F/S. The 250-ton prototype shear was received and installed. Priorities were established for development work on graphite fuels. A total of 5 SRE Core I fuel clusters were mechanically dejacketed from the second carrier shipment of SRE Core I fuel. Degradation of NaK to a solid or waxy form required that the slugs be ejected by the jackscrew. The NaK disposal system operated satisfactorily for the last ~3000 ml of NaK. A procedure for estimating the temperature rise of spent reactor fuels during shipping gives reasonably good results. A pulse column was operated with the light phase continuous using an external phase separator. Zirconium oxide plates were dissolved by HF in molten salt at rates at least twice as great as for Zircaloy-2 metal in the same system. Magnesium additive to high sulfate Purex waste was tested. (auth)

10103 (ORNL-TM-149) CRITERIA FOR THE DESIGN OF THE THORIUM FUEL CYCLE DEVELOPMENT FACILITY. A. R. Irvine and A. L. Lotts (Oak Ridge National Lab., Tenn.). Mar. 2, 1962. Contract [W-7405-eng-26]. 80p.

Criteria for the conceptual design of the proposed Thorium Fuel Cycle Development Facility to be located at the Oak Ridge National Laboratory were established and are presented. In addition, conceptual layouts of the building and equipment are included. Reference fuel elements and processes that were selected as a basis for developing criteria for the facility are described. (auth)

10104 CONTRIBUTION TO THE STUDY OF THE USE OF ORGANIC SOLVENTS AS ELUTING AGENTS IN CATION EXCHANGE. IV. ON THE POSSIBILITIES OF SEPARATING ZIRCONIUM FROM HAFNIUM. S. Ionescu, C. Grigorescu Sabău, and St. Spiridon. Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 269; 272-3; Z76-7(1961). (In Rumanian)

An effort was made to separate Zr and Hf with KU_2 resin. Variables in the experiments were the length of the chromatographic column, the form of the resin (H^+, NH_4^+, K^+, and Ba^{2+}), and the nature of the eluant, which is formed by mixtures of hydrochloric acid and organic solvents (acetone, methylethyl ketone, diethyl ketone, acetylacetone, and isopropyl alcohol). The various cation forms of the resin, except for the hydrogen form, give the best separations, but the volume of eluant necessary increases in an unfavorable fashion. With respect to the variation of the composition of the eluant, going from acetone to the higher ketones, the elution maxima are reduced by several milliliters, but the two elements are brought closer to being superposed. New variants capable of giving a convenient and total separation are being sought. (tr-auth)

10105 RADIOACTIVITY DISTRIBUTIONS IN THE METALLURGICAL PROCESSING OF THORIUM. R. E. Cofield (Union Carbide Nuclear Co., Y-12 Plant, Oak Ridge, Tenn.). Health Phys., 7: 191-204(Feb. 1962).

The radioactivity distribution patterns produced in the metallurgical processing (particularly casting by consumable arc melting) of thorium metal have been studied. Samples from various locations in the metal, from material deposited on process equipment, and from process area environmental sampling were subjected to gross counting, α- and γ-spectrometry, and growth-decay studies. Separation of thorium and radium and the release of thoron gas are the two important effects observed. A simple γ-spectrometry photopeak ratio method for determining the enrichment or depletion of radium in thorium samples, along with its calibration, is described. The data indicate extensive removal of the radium daughters from thorium in arc-melting, two successive arc-meltings removing essentially all of the Ra^{228}. The radiological hazard and analysis implications of these radioactivity distribution patterns are discussed. (auth)

10106 INVESTIGATIONS ON THE OBTENTION, SEPARATION, AND PURIFICATION OF TANTALUM AND NIOBIUM, CHIEFLY BY ELECTROLYTIC METHODS. III. OBTENTION OF TANTALUM, NIOBIUM, AND VANADIUM BY ELECTROLYSIS OF CRYOLITIC SOLUTIONS OF THEIR PENTOXIDES. R. Monnier, Ph. Grandjean, J. Zahler, J. L. Blanc, and T. Toïa (Université, Geneva). Helv. Chim. Acta, 44: 1862-7(1961). (In French)

The electrolysis of cryolitic solutions of the pentoxides of Ta, Nb, or V gives on the cathode a deposit of the metal of the pentoxides with practically no Al. This result is a confirmation of the primary discharge of the Me^{5+} ions. When operating with a carbon anode, the metals deposited on the cathode are contaminated with carbon, present mainly as carbide. (auth)

10107 SYNERGIC EFFECTS IN THE SOLVENT EXTRACTION OF THE ACTINIDES. II. PLUTONIUM(VI) AND NEPTUNIUM(V). H. Irving and D. N. Edgington (Inorganic Chemistry Lab., Oxford). J. Inorg. & Nuclear Chem., 20: 314-20(Dec. 1961).

By using plutonium-239 and neptunium-237 the solvent extraction of plutonium (VI) and neptunium (V) from nitric acid into mixtures of 1,1,1-trifluoro-3-2′-thenoylacetone (TTA) and tri-n-butyl phosphate (TBP) in cyclohexane was studied. The extraction coefficient is found to be greater for such mixtures than for either component alone. The formula of the species extracted from plutonyl nitrate was shown to be $PuO_2X_2 \cdot TBP$ (where HX = TTA). The species extracted from neptunyl nitrate appears to be $HNpO_2X_2 \cdot TBP$. Some equilibrium constants are reported. (auth)

10108 SYNERGIC EFFECTS IN THE SOLVENT EXTRACTION OF THE ACTINIDES. III. TETRAVALENT ACTINIDES. H. Irving and D. N. Edgington (Inorganic Chemistry Lab., Oxford and Inorganic and Structural Chemistry Dept., Leeds, Eng.). J. Inorg. & Nuclear Chem., 20: 321-34(Dec. 1961).

By using Th^{230}, Np^{237}, and Pu^{239} as tracers, the solvent extraction of the tetravalent actinides from nitric acid into mixtures of 1,1,1-trifluoro-3-2′-thenoylacetone (TTA) with tri-n-butyl phosphate (TBP) or tri-n-butylphosphine oxide (TBPO) in cyclohexane was studied. The extraction coefficients were found to be larger for certain mixtures than for either component alone. With thorium and TTA, the addition of TBP effects the displacement of some of the chelated molecules and a mixture of ThX_4, $ThX_3(NO_3) \cdot TBP$, and $ThX_2(NO_3)_2 \cdot 2TBP$ (where HX = TTA) is co-extracted. Unlike the systems hitherto studied the anion of the mineral acid in the aqueous phase now participates in the composition of the extractable species. With mixtures of TTA and TBPO the displacement of the chelated TTA is even greater and the extractable species $ThX(NO_3)_2 \cdot TBPO$ must be involved. With mixtures of TTA and TBP the extraction of Pu(IV) and Np(IV) appears to involve only the species MX_4 and $MX_3(NO_3) \cdot TBP$ (M = Np or Pu). With mixtures of TTA and TBPO, however, the species extracted are $MX_2(NO_3)_2 \cdot 2TBPO$ with $MX_3(NO_3) \cdot TBPO$ and MX_4. A number of equilibrium constants are calculated and their significance is discussed. Synergic effects among the tetravalent actinides appear to depend upon their ability to achieve a co-ordination number of eight. (auth)

10109 ION EXCHANGE IN MIXED SOLVENTS. V. THE DISTRIBUTION OF HEXAVALENT URANIUM BETWEEN ALCOHOL-HYDROCHLORIC ACID SOLUTIONS AND THE STRONGLY BASIC ANION EXCHANGER DOWEX-1– MECHANISM OF URANIUM ADSORPTION. F. Tera and J. Korkisch (Universität, Vienna). J. Inorg. & Nuclear Chem., 20: 335-9(Dec. 1961).

The influence of aliphatic alcohols upon the adsorption of uranium by the strongly basic anion exchanger Dowex-1 is examined. Equilibrium studies show that the adsorption of uranium as a chloride complex on the resin from solutions containing aliphatic alcohols and hydrochloric acid increases with the concentration and chain length of the alcohol, with decreasing dielectric constant of the medium and with increasing hydrochloric acid concentration. The structure of the adsorbed uranium complex is deduced from these results. (auth)

10110 THE SOLVENT EXTRACTION OF PLUTONIUM AND AMERICIUM BY TRI-n-OCTYLPHOSPHINE OXIDE. B. Martin, D. W. Ockenden, and J. K. Foreman (United Kingdom Atomic Energy Authority, Windscale Works, Cumb, Eng.). J. Inorg. & Nuclear Chem., 21: 96-107 (Dec. 1961). (In English)

The extraction of plutonium in three valency states (III, IV, and V) from nitric and hydrochloric acids of various strengths and the properties of the plutonium(IV and VI)-tri-n-octylphosphine oxide complexes extracted into the organic phase from nitric acid are described. The extraction of americium(III) from nitric acid is also briefly described. Over the range of acidities examined, 0.1M TOPO extracted at least 99.5% of the plutonium(IV) nitrate and 99.5% of the plutonium(VI) nitrate from 0.3 to 0.7N nitric acid. The extraction of plutonium(IV and VI) chlorides was similar to the extraction for plutonium(IV) nitrate. (P.C.H.)

10111 SOLVENT EXTRACTION OF ACTINIDES AND LANTHANIDES FROM MOLTEN SALTS. N. M. Isaac, P. R. Fields, and D. M. Gruen (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 21: 152-68(Dec. 1961). (In English)

Quantitative measurements were made of distribution coefficients of metal ions between a fused salt phase and an organic phase for the first time. The measurements were made at a temperature of 150°C using a $LiNO_3-KNO_3$ eutectic (m.p. 120°C) and tributyl phosphate (TBP) as the active extractant with a mixture of polyphenyls as the inert diluent. Distribution coefficients were determined for Co(II), Eu(III), Nd(III), Am(III), Cm(III), Np(V), Np(VI), and U(VI), and found to be higher by a factor of $\sim 10^2-10^3$ as compared with concentrated aqueous nitrate solutions. The number of TBP molecules associated with the complexes $M(NO_3)_p \cdot (TBP)_q$ in the organic phase were found to be the same [except for Co(II)] as those reported for aqueous nitrate system. The effect of Cl^- addition to the nitrate melt was to lower the distribution coefficients. The separation factor 3.2 for Am(III)/Cm(III) suggests a possible application to the separation of these two elements. (auth)

10112 SYNERGIC EFFECTS IN THE SOLVENT EXTRACTION OF THE ACTINIDES. IV. TRIVALENT PLUTONIUM, AMERICIUM AND EUROPIUM. H. Irving and D. N. Edgington (Dept. of Inorganic and Structural Chemistry, Leeds, Eng. and Inorganic Chemistry Lab., Oxford). J. Inorg. & Nuclear Chem., 21: 169-80(Dec. 1961). (In English)

By using radioactive tracers the solvent extraction of plutonium(III), americium(III), and europium(III) from 0.01N hydrochloric acid, 0.001N nitric acid, and an acetate buffer of pH 3.95 respectively into mixtures of 1,1,1-trifluoro-3-2′-thenoylacetone (TTA) and tri-n-butyl phosphate (TBP) in cyclohexane was studied. The extraction coefficient was found to be greater for such mixtures than for either component alone and the extractable species has the composition $MX_3 \cdot 2TBP$ (where TTA = HX and M = Pu, Am, or Eu). This demonstrates the possibility of eight-fold co-ordination in these elements. When the TBP is replaced by tri-n-butyl phosphine oxide (TBPO) a synergic enhancement of the extraction coefficient is again found. Here the TBPO replaces some of the chelating molecules and the species $MX_2(NO_3) \cdot 2TBPO$ and MX_3 (M = Am or Eu) appear to be co-extracted. Some equilibrium constants are reported. (auth)

10113 PRECIPITATION OF MICROQUANTITIES OF Th^{234} WITH URANIUM OXALATE. A. A. Grinberg and D. N. Bykhovskii. Radiokhimiya, 3: 528-34(1961). (In Russian)

The precipitation of Th^{234} with uranium oxalate from saturated solutions follows a logarithmic distribution formula. The distribution coefficient λ increases with increased oxalate concentration. The isomorphous system $Th^{234}(C_2O_4)_2-U(C_2O_4)_2$ has more stable mixed crystals than the previously studied non-isomorphous system $Ce(III)-U(C_2O_4)_2$. A method is developed for separating Th^{234} from uranium based on the precipitation. (R.V.J.)

10114 EXTRACTION OF U(VI) BY TRIOCTYLAMINE NITRATE SOLUTIONS. V. M. Vdovenko, A. A. Lipovskii, and M. G. Kuzina. Radiokhimiya, 3: 555-66(1961). (In Russian)

U(VI) extraction by trioctylamine (TOA) and separation by anion exchange resin are investigated considering the composition of the aqueous solution. A certain similarity was observed in extraction from HNO_3 solution and from salting-out solutions. Variations in extraction properties of nitrate-TOA solutions containing various diluents are related to the polar properties of the diluents and to reactions in the extraction agent–diluent systems. (R.V.J.)

10115 REMOVAL OF RADIOACTIVE RUTHENIUM AND CESIUM FROM GASES. (to Atomic Energy of Canada, Ltd.). British Patent 889,554. Feb. 14, 1962.

A method of removing ruthenium and cesium from gases is outlined which comprises contacting the gases with a metal oxide to remove the ruthenium and with a refractory silicate to remove the cesium. The metal oxide may be iron oxide, nickel oxide, chromium oxide, cobalt oxide, titanium oxide, or a mixture thereof, and the silicate may be calcium silicate or one of the alumino-silicates. The preferred temperature for the contacting process is 400 to 1000°C. (D.L.C.)

10116 CESIUM SALT CONVERSION PROCESS. (to U. S. Atomic Energy Commission). British Patent 889,674. Feb. 21, 1962.

A method is given for converting complex cyanide salts of cesium, particularly those containing zinc and ferrocyanide ions, into simple cesium salts. The method comprises treating the insoluble complex cyanide salt precipitate with an aqueous suspension of silver carbonate, whereby cesium is left in solution as the carbonate. The reaction may be written as $Cs_2ZnFe(CN)_6 + 2\ Ag_2CO_3 \rightarrow Ag_4Fe(CN)_6(s) + ZnCO_3(s) + Cs_2CO_3(aq)$. The method is particularly suitable for treating complex cyanide salts of Cs^{137} which were precipitated from reactor waste solutions. (D.L.C.)

10117 THE SEPARATION OF PLUTONIUM FROM URANIUM. (to Atomic Energy of Canada Ltd.). British Patent 890,410. Feb. 28, 1962.

A process for the separation of Pu from irradiated U is given which is a modification of the tributyl phosphate extraction-stripping procedure. Tributyl phosphate (TBP) decomposes by hydrolysis and radiolysis to form dibutyl phosphate (DBP) which complexes Pu and makes stripping difficult. The modification consists of regulating the flow rate of the solvent extractant and the stripping solution and/or the time of contact between them so that insoluble $Pu(DBP)_4$ is converted into soluble $Pu(NO_3)_4 \cdot 2TBP$ by reaction with $UO_2(NO_3)_2 \cdot 2TBP$. When the concentration of the DBP complex in the solvent extractant phase exceeds 0.01 vol %, it is also necessary to hold up the flow for a period of time to permit conversion of the DBP complex into the TBP complex. Ferrous ions or hydroxylamine nitrate may be used in the stripping solution to reduce Pu^{4+} to Pu^{3+} to improve the stripping, but in the former case non-aliphatic hydrocarbon diluents must be used as the TBP solvent. (D.L.C.)

10118 ELECTROLYTIC SEPARATION PROCESS AND APPARATUS. Milton E. McLain, Jr. and Morris W. Roberts (to U. S. Atomic Energy Commission). U. S. Patent 3,024,172. Mar. 6, 1962.

A method is given for dissolving stainless steel-clad fuel elements in dilute acids such as half normal sulfuric acid. The fuel element is made the anode in a Y-shaped electrolytic cell which has a flowing mercury cathode; the stainless steel elements are entrained in the mercury and stripped therefrom by a continuous process. (AEC)

10119 SEPARATION APPARATUS. John B. Huff (to U. S. Atomic Energy Commission). U. S. Patent 3,025,143. Mar. 13, 1962.

A furnace apparatus is designed for treating a nuclear reactor waste solution. The solution is sprayed onto a bed of burning petroleum coke which expels water, the more volatile fission products, and nitrogen oxides. Next, chlorine gas is introduced from below which causes aluminum to volatilize as aluminum chloride and along with it certain fission products including Nb^{95} and Zr^{95}. These lose their radioactivity within four years and the long-lived radioactivity remains with the ash, which is stored. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstracts 10410, 10411, 10412, 10420, and 10421

10120 (AD-259722) DESIGN OF A SOURCE FOR A LARGE-SCALE ENVIRONMENTAL GAMMA IRRADIATION TEST FACILITY USING MIXED ISOTOPES (thesis). John J. McGee, Jr. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Mar. 1961. 46p. (GNE/Phys/61-12)

A design is presented of a source for a large-scale, environmental, gamma-irradiation test facility using the isotopes cobalt-60, cesium-137, and europium-152. The source geometry is a six-foot diameter vertical disk with 1,627 small sources mounted in the disk. These small sources are cylinders containing the three isotopes and are mounted with their axes parallel to the axis of the disk. An arbitrary test item with a four-foot diameter face, centered on this source six inches away is exposed to a dose rate of 1.3×10^4 ergs/hr-g(C) as its center. The exposure rate is only eight percent less at the edge of the test item face two feet off the center line. The source contains 705,000 curies of Co^{60}, 1,030,000 curies of Cs^{137}, and 545,000 curies of Eu^{152} and generates heat at the rate of 49,800 BTU/hr. The Co^{60} is irradiated cobalt with a specific activity of 2.9 curies/gm; the Cs^{137} is a processed fission product formed into CsCl powder with a specific activity of 22.0 curies/gm; and the Eu^{152} is irradiated Eu_2O_3 with a specific activity of 14.8 curies/gm. The advantages of this source are its unidirectional geometry which allows the test item to be tested in various orientations, its ability to irradiate large test item faces, its relative effectiveness since both sides of the source may be used, and its flexibility since various source strengths may be obtained by loading less of the small sources. (auth)

10121 (AEDC-TDR-62-51) ANALYTICAL AND EXPERIMENTAL STUDY OF ADAPTING BEARINGS FOR USE IN AN ULTRA-HIGH VACUUM ENVIRONMENT. PHASE I. SCREENING OF WEAR AND FRICTION CHARACTERISTICS OF PLASTICS, DRY POWDERS, COMPOSITES, AND ALLOYS. PHASE II. OUTGASSING DETERMINATION OF PLASTICS, DRY POWDERS, AND COMPOSITES. PHASE III. EVALUATION OF DRY POWDER LUBRICANTS AND SELF-LUBRICATING MATERIALS IN ULTRA-HIGH VACUUM BEARING TESTS. P. H. Bowen (Westinghouse Electric Corp. Materials Labs., East Pittsburgh, Penna.). Feb. 1962. Contract AF49(600)-915. 185p.

Results of an investigation are presented on the dry powder lubrication of gears, bearings, and retainers for use in vacuum environments. The wear and friction characteristics of various dry powders and dry self-lubricating materials for use in ball bearings were evaluated and screened in a dry inert atmosphere in laboratory test apparatus under rotating speeds and loads similar to that found in 2 to 7 h.p. electric motors. The materials evaluated included reinforced thermosetting plastics, dry lubricant filled and unfilled thermoplastics and dry lubricant filled sintered alloys. Dry powder and self-lubricating materials were subjected to the vacuum conditions in the range of 1×10^{-6} to 1×10^{-9} mm Hg, and at −60 to 1000°F to determine the rate of the outgassing and/or decomposition of each material. Dry ball bearing (204 size, 22 mm bore) soaking and operating tests were conducted using retainers fabricated from the most promising materials. The bearings were operated at a speed of 1800 rpm, radial load of 75 lbs, axial load of 5 lbs, and tested under vacuum and temperature conditions previously described. Special bearings and retainer materials were used for exploratory tests up to 1500°F. (auth)

10122 (AEEW-M-102) THE WINFRITH PORTABLE SELF-CONTAINED AIR SAMPLERS, TYPE W.A.S.-1. I. W. Cavell (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Nov. 1961. 16p.

A self-contained air sampler for collecting samples of airborne particulates on a standard 6-cm filter paper is described. Its construction, use, and performance are discussed. (auth)

10123 (APEX-666(Pt.2)) FLUID AMPLIFIER DEVELOPMENT. Final Report on the Development Program of the Advanced Control Components Unit. N. Haberman, J. F. Hemmenway, J. G. Hiniker, P. J. Horvath, W. C. Kuhlman, A. G. Robison, J. A. Russell, A. L. Spivak, and D. L. West (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 15, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 27p.

Final development work on fluid amplifiers is discussed. A pneumatic servo valve having no moving parts, a special amplifier for high temperature use, and other efforts in connection with this device are described. Capabilities of the fluid amplifier as a high-reliability servo valve are discussed. (auth)

10124 (DC 56-12-104) DESIGN PROPOSAL—2100°F BRAZING FURNACE, VACUUM OR HYDROGEN ATMOSPHERE. S. E. Eckard, R. D. Etheridge, and P. T. Ryan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 14, 1956. Contract AT(11-1)-171. 21p.

A design proposal for a 2100°F brazing furnace for either a hydrogen atmosphere or a vacuum is presented. A cost estimate, elementary control circuit, and method used for heat transfer calculation are included. (auth)

10125 (DC 59-11-164) CLEANING BY ION BOMBARDMENT. J. J. Roseman (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 28, 1959. Contract AT(11-1)-171. 14p.

An investigation was made on the use of ion bombardment as a cleaning process for the removal of thin contaminant films from bonding faces. Improvement in bond strength is desired by the use of this technique. An apparatus is described which was constructed to perform ionic bombardment cleaning and metal sputtering of the cleaned surface. Initial work was done on cleaning a Cr core which was to be bonded to a metallic Fe−Cr−Y cladding. (auth)

10126 (DC-59-12-28) GEAR TYPE PNEUMATIC SERVO MOTOR COMBINED WITH A 4-WAY SERVO VALVE. John R. Colston (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 1959. Contract AT(11-1)-171. 29p.

A performance investigation was made of a pneumatic servo motor combined with a 4-way servo valve. The air motor was performance tested as a unit and also in a motor-valve combination. An analysis was also made of the combinations. This pneumatic motor-valve combination may be utilized as a rotary actuator with valve supply pres-

sure as low as 40 psig and temperatures as high as 225°F. (auth)

10127 (DC-60-6-37) FABRICATION AND CALIBRATION OF A SMALL DIAMETER FLOW NOZZLE FOR PROBE CALIBRATION (MILESTONE V, TASK 4341-1-1). F. E. Simkins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 1, 1960. Contract AT(11-1)-171. 15p.

Calibration results on a one-inch diameter jet to be used for probe calibration purposes for an experimental fluid dynamics and thermodynamics unit are presented. Variations in total pressure and static pressure at various positions in the jet were measured at Mach numbers at the nozzle exit plane up to 0.90. (auth)

10128 (EURAEC-50) STUDIES ON INDUCED VIBRATION AND PRESSURE DROP IN TUBE BUNDLES. Quarterly Report No. 1, 4th Quarter, 1960. P. Leon (Société Grenobloise d'Etude et d'Applications Hydrauliques, Grenoble, France). Work performed under United States-Euratom Joint Research and Development Program. Contract [025-60-10-RDF]. 14p.

A bibliographical search into theoretical and experimental studies on similar subjects was carried out. Tests were developed to measure experimentally the natural vibration frequencies of simple mechanical models of two types: those having only one tubular element and those formed by identical tubular elements grouped in clusters of parallel tubes. Both hollow and solid stainless steel tubes will be used in the tests. (M.C.G.)

10129 (GAT-T-816) FLUORINE CELLS WITH PROTECTED ANODE CLAMPS. M. R. Hertz and R. P. Nugent (Goodyear Atomic Corp., Portsmouth, Ohio). June 30, 1961. Contract AT-(33-2)-1. 13p.

Corrosion of anode clamp assemblies in fluorine generation cells proved to be a major factor in limiting cell life. Several attempts were made to protect clamp assemblies by encapsulating them in frozen electrolyte or synthetic resin. The use of frozen electrolyte, while successful in small laboratory cells, was not successful in plant tests because of difficulties in obtaining watertight welded or brazed cooling water connections. A brief test of a four-anode cell incorporating epoxy resin-calcium fluoride encapsulation of the anode clamps was conducted, and preliminary results indicated that extended cell life may be obtained. (auth)

10130 (HW-71314) A 2-1/2-INCH DIAMETER TELEVISION CAMERA. A. N. Iverson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1961. Contract AT(45-1)-1350. 15p.

A television camera $2\frac{1}{2}$ inches diameter by 23 inches long was fabricated and used for inspecting the interior of a shut-down reactor. The field of view is $2\frac{1}{2}$ inches wide by 2 inches high when operating in a 4-inch square channel. The total radiation dosage received to date is greater than 500,000 r with excellent picture quality. (auth)

10131 (KAPL-2180) STRESS ANALYSIS OF A PRESSURE-VESSEL HEAD WITH SQUARE HOLES. Lorenzo Deagle (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 5, 1962. Contract W-31-109-eng-52. 63p.

The results of a photoelastic stress analysis of a pressure vessel head with 9 square holes are given. These results are compared with the results of a theoretical stress analysis. (auth)

10132 (NP-11405) DYNAMIC STRESS CONCENTRATIONS IN AN ELASTIC PLATE WITH RIGID CIRCULAR INCLUSION. Yih-Hsing Pao and C. C. Mow (Mitre Corp., Bedford, Mass.). Dec. 1961. Contract AF33(600)-39852. 35p. (SR-41)

Stress concentrations around a rigid circular inclusion in a thin, elastic plate during passage of plane compressional waves were examined. The inclusion can be either fixed in space or free to translate with the plate. The dynamic stress concentration factors were found to be dependent upon the incident wave length, Poisson's ratio of the plate, and density of the inclusion. At certain wave lengths the dynamic factors were larger than those encountered in the static case. Very large local stresses might develop if the inclusion was constrained and unable to move freely with the plate. (auth)

10133 (ORNL-TM-128) DEVELOPMENT OF FREEZE VALVE FOR USE IN THE MSRE. M. Richardson (Oak Ridge National Lab., Tenn.). Feb. 28, 1962. Contract W-7405-Eng-26. 21p.

Three types of frozen-seal "valves" were tested for possible use in the MSRE. The seal was melted by direct resistance heat, by induction heat, and by clamp-on Calrod heat. The frozen seal was made in a preformed restriction section of a standard piece of pipe by a cooling-gas jet stream directed at the restriction. All three valves performed satisfactorily through 100 test cycles. The Calrod-heated valve was selected for MSRE use on the basis of simplicity of design and of operation. Two of the valves are successfully undergoing further tests on the MSRE Engineering Test Loop. (auth)

10134 (UCRL-6722) Al_2O_3 FOILS CAPABLE OF TRANSMITTING HIGH-CURRENT RELATIVISTIC ELECTRON BEAMS. William A. Sherwood and Ross E. Hester (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 28, 1961. Contract W-7405-eng-48. 13p.

High quality Al_2O_3 foils, 50 to 70 $\mu g/cm^2$ thick by 1 inch in diameter, were developed and tested. The foils were made from anodized pure aluminum discs and coated with a thin layer of carbon (about 400A). Tests of these foils showed that they will withstand a pressure differential of 2 mm Hg while being bombarded by 0.3-μsec pulses of 0.250 amp/cm^2 10-kv electrons at 300 pps. Integrated energy spectra of electrons (E_0 = 10 kv) transmitted by 1600A aluminum oxide plus 400A carbon foils showed that particle transmission is $\leq$ 65%, and indicated that they will withstand a d-c power absorption of $\geq$ 0.1 watt. (auth)

10135 AN IMPROVED RADIO-FREQUENCY ION SOURCE. Yuin-Chi Hsue. Ho Tsu K'o Hsueh, 2: No. 3, 14-19(1958). (In Chinese)

A beam current of 1500 μA containing 90% protons was obtained at a gas pressure of 1×10^{-2} mm. Hg. An electrodeless high frequency ion source induced by a 27.5 mc oscillator coupled with a high-pressure direct-current source of 250 kv is used. The ions are further accelerated by a magnetic field placed at right angles to the electric axis. This is claimed to be the feature. (TTT)

10136 INDUSTRIAL EXPLOITATION OF THE ULTRAVACUUM. J. Amoignon. Inds. atomiques, 5: No. 9-10, 107-12(1961). (In French)

The actual limits of diffusion pumps in the ultravacuum region are first reviewed. Different accessories permitting the reasonable utilization of these types of pumps are then briefly described. A brief review of the results obtained is then outlined. (tr-auth)

10137 RESEARCH ON THE COLLISION RESISTING CONSTRUCTION OF THE SIDES OF A NUCLEAR POWERED SHIP. NO. 1. Mitsubishi Nippon Jukogyo Giho, 2: 12-20 (1961). (In Japanese)

Eight types of ship-side constructions were investigated as protective construction of the reactor space, using 1/20 models for a 45000 DWT tanker. By applying an impact load to each type of ship-side construction model, under equal conditions, endeavours were made to ascertain the most effective construction of the ship-side against collision. (auth)

10138 IMPROVEMENTS IN OR RELATING TO MAGNETIC COUPLINGS. (to Commissariat à l'Energie Atomique). British Patent 889,477. Feb. 14, 1962.

A device for transmitting mechanical motions through a plane wall by magnetic coupling is designed which has a coupling strength superior to those of other known couplings. The device comprises two identical assemblies, one on each side of the wall, each assembly comprising a horseshoe-shaped magnet and a soft iron member secured to the magnet in a direction perpendicular to the magnet pole axis. The device is arranged so that the magnetic field of each magnet passes through the wall and completes its circuit through the soft iron member secured to the other magnet. (D.L.C.)

10139 IMPROVEMENTS IN RACKS OR CABINETS FOR HOUSING ELECTRONIC AND SIMILAR EQUIPMENT. Louis Dano and Roger Viguie (to Commissariat a l'Energie Atomique). British Patent 889,923. Feb. 21, 1962.

A rack or cabinet is designed for housing light electronic elements, e.g., circuits, transistors, and miniature and subminiature tubes. The rack comprises a frame which is divided into individual compartments by a plurality of chassis slides, each slide carrying electronic components and means for making electric connections. (D.L.C.)

10140 IMPROVEMENTS IN OR RELATING TO JOINTS, FOR EXAMBLE, FOR PIPES. Harry Chilton (to United Kingdom Atomic Energy Authority). British Patent 890,061. Feb. 21, 1962.

A pipe joint such as that described in British Patent 849,123 is improved in order to minimize the thermal effect on the joint due to a sudden change in the temperature of the conveyed fluid. The joint comprises two hollow members with plane surfaces held in contact by internal clamping means having a thermal expansion coefficient different from at least one of the members and being arranged to be contacted by fluid flow through the members. (D.L.C.)

10141 IMPROVEMENTS RELATING TO PRESSURE VESSELS. Victor Leonard Summerfield (to Babcock & Wilcox Ltd.). British Patent 890,442. Feb. 28, 1962.

A pressure vessel with its wall formed with criss-crossed rows of closely spaced apertures containing tubular means is designed for gas-cooled reactors. The tubular means are nozzles welded to the wall in such a way that nozzles extend away from both sides of the wall in an alternating pattern to increase the access space available between nozzles to make the welds between each nozzle and the wall. (D.L.C.)

10142 CONDENSATION CAN. E. T. Booth, Jr., R. B. Pontius, B. A. Jacobsohn, and C. B. Slade (to U. S. Atomic Energy Commission). U. S. Patent 3,024,009. Mar. 6, 1962.

An apparatus is designed for condensing a vapor to a solid at relatively low back pressures. The apparatus comprises a closed condensing chamber, a vapor inlet tube extending to the central region of the chamber, a co-axial tubular shield surrounding the inlet tube, means for heating the inlet tube at a point outside the condensing chamber, and means for refrigerating the said chamber. (AEC)

10143 APPARATUS FOR VACUUM DEPOSITION OF METALS. Norman Milleron (to U. S. Atomic Energy Commission). U. S. Patent 3,024,965. Mar. 13, 1962.

An apparatus and a method are described for continuous vacuum deposition of metals for metallic coatings, for ultra-high vacuum work, for purification of metals, for maintaining high-density electron currents, and for other uses. The apparatus comprises an externally cooled feeder tube extending into a container and adapted to feed metal wire or strip so that it emerges in a generally vertical position therein. The tube also provides shielding from the heat produced by an electron beam therein focused to impinge from a vertical direction upon the tip of the emerging wire. By proper control of the wire feed, coolant feed, and electron beam intensity, a molten ball of metal forms upon the emerging tip and remains self-supported thereon by the interaction of various forces. The metal is vaporized and travels in a line of sight direction, while additional wire is fed from the tube, so that the size of the molten ball remains constant. In the preferred embodiments, the wire is selected from a number of gettering metals and is degassed by electrical resistance in an adjacent chamber which is also partially evacuated. The wire is then fed through the feed tube into the electron beam and vaporizes and adsorbs gases to provide pumping action while being continuously deposited upon surfaces within the chamber. Ion pump electrodes may also be provided within line of sight of the vaporizing metal source to enhance the pumping action. (AEC)

10144 SHOCKPROOF MAGNETIC REED SWITCH. E. Medal (to U. S. Atomic Energy Commission). U. S. Patent 3,025,371. Mar. 13, 1962.

A shockproof magnetic reed switch is described which comprises essentially a plurality of pairs of reed contacts of magnetic, electrical conducting material which are arranged generally in circumferential spaced relationship. At least two of the pairs are disposed to operate at a predetermined angle with respect to each other, and the contacts are wired in the circuit, so that the continuity, or discontinuity, of the circuit is not affected by a shock imposed on the switch. The contacts are hermetically sealed within an outer tubular jacket. (AEC)

10145 SWITCHING TRANSMITTER POSITIONING OF SYNCHROS. H. Wolff (to U. S. Atomic Energy Commission). U. S. Patent 3,025,442. Mar. 13, 1962.

A transformer apparatus is designed for effecting the step positioning of synchro motors. The apparatus is provided with ganged switches and pre-selected contacts to permit the units and tens selection of the desired angular position for the synchro motor rotor with only the movement of two selector knobs required. With the selection thus made, the appropriate pre-selected signal is delivered to the synchro motor for positioning the rotor of the latter as selected. The transformer apparatus is divided into smaller arrangements to conform with computed trigonometric relations which will give the desired results. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstract 10408

10146 (DC-57-1-55) EXPERIMENTAL INVESTIGATION OF THE AERODYNAMIC PERFORMANCE FOR SEVERAL BI-CONVEX STRUT CONFIGURATIONS IN DUCTS. C. R. Weeden and R. L. Jones (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 31, 1956. Contract AT(11-1)-171. 40p.

Results of a study of air flow through a duct containing staggered rows of streamlined struts with axis normal to the air stream are presented. Experimentally determined loss characteristics for several configurations of bi-convex struts are presented as parameters. They are used to graphically compare the effect of strut arrangement upon air flow. A range of Reynolds numbers from 10^5 to 10^6 and Mach numbers up to choke were developed as the air flow was metered to the configurations. A plot of data shows the effect of void volume fraction upon the over-all pressure loss coefficient, $\Delta P_T/q$. (auth)

10147 (TID-14825) FLUID-SOLID HEAT TRANSFER STUDY. Progress Report No. 1. (Report No. 2). Robert S. Brodkey (Ohio State Univ. Research Foundation, Columbus). Dec. 1961. Contract AT(11-1)-774. 14p.

The design and construction of equipment for studying heat transfer in the flow of gases through fluidized solids are described. Preliminary empty-bed and packed-bed tests on the equipment are summarized. Theoretical aspects of the heat transfer, including the effects of surface transfer, gas mixing, and solids mixing, are studied. A linear theoretical model of the system is developed. (T.F.H.)

10148 (TID-14993) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report for January 1962. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Jan. 31, 1962. Contract AT(30-3)-187. 6p. (MPR-XIII-1-62)

Assembly of the hot rod test section is complete. Bench scale tests to predict the performance of the burnout detector while using Inconel X heater tubes indicated the desirability of conducting a short test program including one burnout. Assemblies for this test are being readied. Analytical studies were initiated aimed at relating transient temperature data during burnout or other thermal transients in an electrically heated simulation to similar transients in fuel elements. The approaches include use of exact solutions, use of heat and mass flow analyzer, and use of the Liebman resistor network. In other work, fabrication of the high flux 19-rod test section was initiated, and design of a test section was begun. (J.R.D.)

10149 (TID-15016) COMBINED FORCES AND FREE TURBULENT CONVECTION IN A VERTICAL TUBE (thesis). Technical Report No. 12. M. S. Ojalvo and R. J. Grosh (Purdue Univ., Lafayette, Ind.). Jan. 1962. Contract AT(11-1)-1026. 84p.

An analytical study was made of turbulent heat transfer in a vertical circular tube under the conditions of combined forced and free convection with uniform wall heat flux. The basic conservation laws were reduced to three coupled, linear integro-differential equations in which the parameters are: Prandtl number, Pr; Rayleigh number, Ra; and friction Reynolds number, Re^*. The following values of these parameters were investigated: Pr = 1, 10, 100; Ra = 0, 16, 81, 100, 256, 400, 625, 800; and $Re^* = 0, 10^3, 10^4, 10^5$. The IBM 704 digital computer was used to solve the three equations for the fully developed velocity profile, temperature profile, and pressure drop. An extension of these results yielded the mixed-mean-to-wall temperature difference, Nusselt number, and Reynolds number for a given problem. The results for turbulent heat transfer, combined forced and free convection problems showed that the pressure drop parameter, C, and the Nusselt number, Nu, increase by approximately an order of magnitude as Re^* increases from 0 to 10^3 to 10^4 to 10^5. The Prandtl number, Pr, has a smaller effect on C and Nu, decreasing the former and increasing the latter as Pr increases. Increasing Re^* decreases the mixed-mean-to-wall temperature difference, ϕ_M, by approximately an order of magnitude for the Re^* change given above. Increasing Pr has a smaller effect on decreasing ϕ_M, than increasing Re^*. The temperature difference profile tends to become smaller and flattened as Re^* is increased. Increasing the Prandtl number has the same effect, but to a lesser extent. The temperature difference at the center of the tube approaches zero as the Rayleigh number is increased. The velocity in the center of the tube is lowered and becomes more and more negative as the Prandtl number is decreased and as the Rayleigh number is increased. Increasing Re^* has the same effect for Pr = 1; but, for Pr = 10 or Pr = 100, the velocity in the center of the tube becomes less negative when Re^* is increased from 10^4 to 10^5. (auth)

10150 (UCRL-5692) TEMPERATURES AND THERMAL STRESSES IN HEXAGONAL TUBES AND PIERCED PLATES WITH INTERNAL HEAT SOURCES. Robert B. Meuser (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 22, 1959. Contract W-7405-eng-48. 56p.

Steady temperatures and thermal stresses are determined for long hexagonal tubes having round holes for the case of uniform internal heat generation and a fluid-cooled inside surface. Thermal stresses are also determined for thick plates pierced by holes on an equilateral triangular pattern and for hexagonal tubes having a hexagonal hole with rounded inside corners. Stresses in the end regions of tubes are also investigated. In all cases it was found that the maximum tensile stress was within ±20% of that occurring in an equivalent thick-walled circular tube. (auth)

10151 (UCRL-6665-T) FLASHING EXPANSION OF WATER THROUGH A CONVERGING-DIVERGING NOZZLE (thesis). Robert Alan Brown (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 24, 1961. Contract W-7405-eng-48. 79p.

An investigation was made of the flow characteristics of high pressure, high temperature water in the expansion through converging-diverging nozzles and experimental values were compared to those calculated from idealized models. Experimental data were obtained over a range of flow rates and chamber conditions for two de Laval type nozzles. When compared with two elementary flow models, the flow rates and pressure profiles were found to reflect the degree of sub-cooling in the chamber. Flow rates were smaller than predicted by incompressible flow considerations and considerably larger than predicted by equilibrium assumptions. The possibility of a metastable state existing is proposed, and a physical limitation from basic kinetic theory is imposed upon the extent of the non-equilibrium. A two-step theory embodying a discontinuous change to two-phase flow evolves from the metastable state assumption. The observed flow rates and pressure profiles are found to be explainable by this model for subcooling values in excess of 5°F. (auth)

10152 (AEC-tr-4998) FLOW DISTRIBUTION IN A HOLLOW APPARATUS HAVING DIFFERENT TYPES OF GAS INLETS. I. M. Khanin, S. M. Ivanov, and M. B. Kartsinel. Translated for Oak Ridge National Lab., Tenn. from Dopovidi Akad. Nauk Ukr. R.S.R., No. 3, 316-20(1961). 7p.

An investigation was made of the effects of the diameter of the inlet and its position on the character of gas flow distribution in hollow absorbent apparatus. Six types of gas inlets were studied. An increase in the inlet diameter was found to improve the gas distribution in the apparatus, the number of inlets having no significant effect on the flow structure. The use of radial inlet was experimentally

proved to be inexpedient. On the basis of the results, recommendations are given for using one tangential inlet or an inlet placed on a secant in commercial hollow absorbent apparatus. (auth)

10153 (FTD-TT-62-52) BOILING HEAT TRANSFER. S. S. Kutateladze. Translated from paper prepared for presentation at "Pervoe Vsesoyuznoe Soveshchanie po Teplo- i Massoobmenu, 5-10 Iyunya, 1961, Minsk." 32p.

An analysis of problems associated with heat transfer in nucleate boiling is presented. The principal points of the boiling heat-transfer theory are discussed and results of experimental work are generalized. (J.R.D.)

10154 (FTD-TT-62-55) THE BOILING CRISIS AND THE THERMODYNAMIC STABILITY OF A LIQUID. V. P. Skripov. Translated from paper prepared for presentation at "Pervoe Vsesoyuznoe Soveshchanie po Teplo- i Massoobmenu, 5-10 Iyunya, 1961, Minsk." 10p.

Aspects of boiling were examined. It is concluded that practically complete cessation of nucleate boiling is due to attainment of the maximum possible superheated liquid temperature at the hot wall, taking wetting conditions into account. The maximum superheating is determined irrespective of heat-transfer phenomena, and is similar in nature to the thermodynamic crisis of the liquid phase stability at a specified external pressure. (J.R.D.)

10155 (FTD-TT-62-57) HEAT TRANSFER AND TURBULENT HEAT TRANSPORT IN A FLOW OF LIQUID METALS. V. I. Subbotin, M. Kh. Ibragimov, M. N. Ivanovskii (Ivanoskiy), M. N. Arnol'dov, and E. (Ye.) V. Nomofilov. Translated from paper prepared for presentation at "Pervoe Vsesoyuznoe Soveshchanie po Teplo- i Massoobmenu, 5-10 Iyunya, 1961, Minsk." 15p.

Results of experiments are presented on heat transfer coefficient and temperature field measurements in flowing liquid alkali metals and heavy metals. Experiments were also conducted to measure the temperature fields of water. (J.R.D.)

10156 (FTD-TT-62-58) CONVECTION HEAT TRANSFER IN A VORTEX FLOW UNDER PRESSURE. G. N. Delyagin. Translated from paper prepared for presentation at "Pervoe Vsesoyuznoe Soveshchanie po Teplo- i Massoobmenu, 5-10 Iyunya, 1961, Minsk." 14p.

The features of hydrodynamics and convection heat transfer were examined in an eddy flow moving in the entrance section of a cylindrical tube. The convection heat transfer in gas eddy flow was found to be a function of the vorticity and independent of pressure. The treatment of eddy flow heat transfer in the entrance section of a tube as heat transfer to a longitudinally streamlined plate was proven to be valid. (D.L.C.)

10157 (FTD-TT-62-61) A STUDY OF HEAT TRANSFER IN A FLUIDIZED BED WITH INTERNAL HEAT SOURCES. N. I. Syromyatnikov, L. K. Vasanova, and Yu. N. Shimanskii (Shimanskiy). Translated from paper prepared for presentation at "Pervoe Vsesoyuzne Soveshchanie po Teplo- i Massoobmenu, 5-10 Iyunya, 1961, Minsk." 7p.

An experiment is described which was used to examine a method for investigating heat transfer in fluidized beds with internal heat sources. The method is based on the assurance of a continued supply of heat in a mass of particles by eddy currents when an apparatus with a fluidized bed is introduced into a high-frequency magnetic field. Control of the heat supply from eddy currents depends on frequency and strength of the magnetic field, the particle size, and the electromagnetic properties of the particles. (J.R.D.)

10158 (FTD-TT-62-62) THE INFLUENCE OF CHANNEL GEOMETRY ON CRITICAL THERMAL LOADS WITH FORCED FLOW OF WATER. B. A. Zenkevich, O. V. Remizov, and V. I. Subbotin. Translated from paper prepared for presentation at "Pervoe Vsesoyuznoe Soveshchanie po Teplo- i Massoobmenu, 5-10 Iyunya, 1961, Minsk." 13p.

The critical thermal loads for channels having various configurations were investigated on a high-pressure circulation stand. Resulting data are presented on critical thermal loads during boiling of forced-flow water in triangular, rectangular, and annular tubes. (J.R.D.)

10159 (FTD-TT-62-69) A METHOD FOR STUDYING HEAT TRANSFER IN AN INTERMITTENT GASDYNAMIC PROCESS. Yu. A. Polyakov and E. (Ye.) A. Mit'kina. Translated from paper prepared for presentation at "Pervoe Vsesoyuznoe Soveshchanie po Teplo- i Massoobmenu, 5-10 Iyunya, 1961, Minsk." 14p.

A method for studying heat transfer in relation to the nonsteady-state temperature of the surfaces of bodies in high speed processes by use of film transducers is developed. Results of heat transfer experiments using this method are discussed and it is noted that the method can be applied to study of heat transfer in intermittent gasdynamic processes if the ionization signals are sufficiently small compared with heat signals. (J.R.D.)

10160 (UCRL-Trans-476(L)) CONTRIBUTION OF THERMAL RADIATION TO THE HEAT CONDUCTION PROCESS. L. Genzel. Translated by Esther Fultz (Univ. of California Lawrence Radiation Lab., Berkeley) from Z. Physik, 135: 177-95(1953). 41p. (Includes original, 19p.).

The physical-mathematical relations for the energy flow and the temperature gradient are calculated in the case of one-dimensional heat conduction processes for which the radiation of the material, as well as the irradiation from boundary surfaces is significant compared with the true heat of conduction. (auth)

10161 CORRELATION OF HYDROGEN HEAT TRANSFER IN BOILING AND SUPERCRITICAL PRESSURE STATES. R. C. Hendricks, R. W. Graham, Y. Y. Hsu, and A. A. Medeiros (Lewis Research Center, Cleveland). ARS (Am. Rocket Soc.) J., 32: 244-52(Feb. 1962).

The use of hydrogen as a working fluid in both chemical and nuclear propulsion systems necessitates convective heat transfer information over a broad range of fluid states. Current heat transfer correlation schemes available in the literature are discussed in terms of their applicability to hydrogen heat transfer. Similarities in the subcritical and supercritical (pressure) heat transfer mechanisms and associated experimental data are reported. Summarized are correlation schemes formulated from heated tube data which apply to: 1) film boiling of liquid hydrogen; 2) hydrogen at supercritical pressure just above and below critical temperature; and 3) low temperature hydrogen (150 to 250°R) above the critical pressure. Parts 1 and 2 have required correlation schemes that depart from the conventional convective pipe flow concepts. It does appear that the conventional pipe flow heat transfer theory can be applied to part 3. (auth)

10162 COMBINED LAMINAR FLOW FORCED AND NATURAL CONVECTION IN VERTICAL ROUND TUBES. J. Madejski (Inst. of Fluid-Flow Machinery, Polish Academy of Sciences, Danzig). Bull. acad. polon. sci., Ser. sci. tech., 9: 633-7(1961). (In English)

The compressibility of a fluid is described by the coefficient of cubic thermal expansion and the isothermal coefficient of bulk compressibility. The following considerations assume that the latter may be neglected in comparison with

the former. Therefore the conclusions are valid only for liquids, with exceptions for gases under suitable conditions. When a fluid flows in a tube, under the action of pressure drop, the mean velocity is constant throughout the tube if the flow is stationary. If, however, the tube is heated or cooled, the buoyant forces cause increased or decreased velocity. Thus, the mean velocity is variable, even if the mass rate of flow is constant. Two basic cases are pointed out for vertical tubes: parallel flow (downward flow of cooled fluid and upward flow of heated fluid) and counter-flow. In the first case the mean velocity decreases in the direction of flow; in the second case it increases. (N.W.R.)

10163 APPARATUS FOR IMPROVING HYDRODYNAMIC CONDITIONS WITHIN A CONDUIT. W. T. Furgerson and G. Samuels, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,027,143. Mar. 27, 1962.

An improved header is designed for eliminating the phenomena of boundary growth, boundary separation, and boundary flow reversal within a divergent passageway having an equivalent cone angle greater than 20°. The header is disposed at the inlet end of an annular divergency and adapted to distribute a rotational fluid flow across that inlet end. Vane means are mounted adjacent the inlet end to establish within the divergent passageway a solid body rotation having both a rotational component of fluid velocity and an axial component of fluid velocity in the direction of the divergence. The vane means are so constructed as to direct a substantial portion of the inlet flow toward both walls of the divergence and a drag ring on the bottom of the vanes will cause a substantially greater portion of the inlet flow to be directed toward one wall than toward the other wall of the annular passageway to eliminate any defects which were not eliminated by solid body flow. (AEC)

Instrumentation

Refer also to abstracts 9771, 10407, and 10416

10164 (AD-259821) ION BEAM APPROACH TO MICROCIRCUITRY. PHASE I. Final Report. (Varo, Inc. Research and Development Div., Garland, Tex.). June 1961. Contract NOnr 3167(00). 22p.

A research program is described which concerns the development of a technique for fabricating microminiaturized electronic circuits by deposition from controlled ion beams. The present state of the art permits the essentially 2-dimensional deposition of resistive, conductive, dielectric and magnetic materials on suitable substrates. Metallic or photoresist masks are used to control the geometry of the deposited material. The proposed apparatus for ion beam deposition is shown schematically. An experimental ion source was built as a first step toward the development of a deposited circuitry system using a directed beam of ions. (auth)

10165 (CERN-61-31) AN ANALYSIS OF RESULTS FROM THE PROTOTYPE H.P.D. M. Benot, T. Lingjaerde, G. W. Moorhead, and B. W. Powell (European Organization for Nuclear Research, Geneva), P. V. C. Hough and R. B. Palmer (Brookhaven National Lab., Upton, N. Y.), J. A. G. Russell and H. W. White (California. Univ., Berkeley. Lawrence Radiation Lab.), and D. Lord (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England). Dec. 8, 1961. 20p.

A brief description is given of the operation of the Hough-Powell Device, an instrument for the high-speed measurement of bubble chamber photographs using a flying spot method in which the coordinates are transmitted directly to an on-line computer. Test results made with the prototype device at CERN confirm that rapid, precise measurements are possible on bubble chamber pictures of normal quality. (D.L.C.)

10166 (CREL-781) A SOLID-STATE PULSE HEIGHT ENCODER. L. B. Robinson and J. S. MacDonald (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1961. 43p. (AECL-1406)

A transistorized analog-to-digital pulse height encoder is described. A pulse height-to-time conversion technique is used with an encoding time of 1 μsec/channel. A description of the design approach is included along with information concerning circuit parts and an application example. (J.R.D.)

10167 (CREL-1063) A DIGITAL SPECTRUM STABILIZER FOR PULSE ANALYZING SYSTEMS. J. A. Ladd and J. M. Kennedy (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1961. 34p. (AECL-1417)

A device is described which may be used generally for the stabilization of pulse spectra in time or amplitude analysis. The device uses a digital technique to generate a correction voltage, which may be fed to any appropriate point in the counting system to correct for spectrum drift and instabilities. A mathematical analysis of the stabilizing properties is included together with practical experimental arrangements and results. (auth)

10168 (DC-57-1-103) HYSTERESIS RELAY. A. D. Wilcox (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 23, 1957. Contract AT(11-1)-171. 17p.

Design and operation of an all-magnetic hysteresis relay is described. A laboratory model of this relay was used to control a synchronous motor and it could be modified to control banks of motors including bank sequencing. (J.R.D.)

10169 (DC-57-2-76) NUCLEAR INSTRUMENTS REQUIRED FOR AN EFFECTIVE SHIELD MEASUREMENT PROGRAM TO FULFILL PROJECT AND DESIGN REQUIREMENTS. John Moteff (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 14, 1957. Contract AT(11-1)-171. 46p.

Instruments are listed and various techniques suggested that should be considered in obtaining data that are required to define the radiation levels in and about the shield systems of power plants. The instruments and other detection methods include the following: 4π high pressure gas ionization chamber, 4π gamma scintillation counter, 4π beta counter, end-window beta counter, gamma ionization chamber, Hurst fast neutron dosimeter, BF_3 thermal neutron counter, photographic films, chemical dosimeters, glass dosimeters, threshold detectors, resonance detectors, 256 channel analyzer, and associated equipment. (auth)

10170 (DC-57-7-98) AN INTRODUCTION TO MAGNETIC AMPLIFIERS. Jack A. Russell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 8, 1957. Contract AT(11-1)-171. 78p.

The principles and characteristics of magnetic amplifiers are discussed. The saturable reactor with resistive load and free even harmonics is considered. Feedback is discussed. Various magnetic amplifier circuits and other types of magnetic devices are described. (D.L.C.)

10171 (DC-57-11-195) THE USE OF PULSE TRANSFORMERS WITH FISSION CHAMBERS AND FISSION CHAMBER PREAMPLIFIERS. G. K. Rusch (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). November 29, 1957. Contract AT(11-1)-171. 38p.

The way in which the turns ratio of a transformer affects the gain and stability of a preamplifier utilizing transformer coupling to a matched coaxial cable is shown. In addition, the signal input to the preamplifier can be maximized by using pulse transformers to match fission chamber capacitance to the capacitance of the preamplifier input circuit. (auth)

10172 (DC 59-2-101) SOME FUNDAMENTAL PRINCIPLES OF FEEDBACK CONTROL SYSTEMS. G. E. Gorker and J. C. Gelhard (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 1, 1959. Contract AT(11-1)-171. 326p.

A series of nine lectures is presented on feedback control system design techniques. The material covered include concepts, stability, responses, use of analog computers in design, and nonlinear systems. (D.L.C.)

10173 (DC-59-5-16) HIGH-SPEED SCALER–BERKELEY MODULAR. J. L. Beene (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 24, 1959. Contract AT(11-1)-171. 15p.

A high speed decade scaler, designed to accept positive input pulses is described. Minimum input pulse should not be less than 5 volts or less than 0.4 microseconds duration. It can be gated "on" by a mechanical clock, manual switch or by an electronic gate. There are no linear amplifier circuits contained in this scaler as it is intended that a linear amplifier drive the scaler. (auth)

10174 (DC 59-11-29) IONIZATION CHAMBER CURRENT. N. M. Gralenski (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 4, 1959. Contract AT(11-1)-171. 66p.

Analysis and solution of the problem of calculating the electrical current which can pass through cylindrical ionization chambers in which the filling gas is the neutron absorber are presented. The solution is a general one and considers such things as wall losses and degree of isotropism of neutron flux. Although the solution is worked out for cylindrical chambers it is applicable to any geometrical shape for which an average thickness can be calculated. (auth)

10175 (DC-59-12-36) THE THERMO ANEMOMETER ALNOR TYPE 8500. F. E. Simkins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 24, 1959. Contract AT(11-1)-171. 11p.

A description is presented of the Thermo Anemometer in use in the Experimental Fluid Dynamics and Thermodynamics Unit. Its use, operating instructions, and yaw and pitch versus velocity curves for the probe and a sketch of the probe assembly and the indicator are covered. (auth)

10176 (DC 60-2-145) TRANSISTORIZED D-C MICROVOLTMETER. W. E. Sabin (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 15, 1960. Contract AT(11-1)-171. 38p.

A chopper type feedback amplifier employing transistors is described and evaluated. The instrument has a normal sensitivity of ±100 μ-volts, full scale, and a precision of 0.2% over a 24 hr period. The sensitivity can be increased to 1 μ-volt with a precision of 20%. Some of the limitations of this type transistorized instrument are discussed and the methods of circumventing them are indicated. Special instructions for the maintenance of the instrument are also included. (auth)

10177 (DC-60-2-163) THE USE OF THE CHROMEL A VERSUS 875 ALLOY THERMOCOUPLE SYSTEM FOR MEASUREMENT OF FUEL ELEMENT AND DISCHARGE AIR TEMPERATURE. J. W. Glasgow (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 22, 1960. Contract AT(11-1)-171. 40p.

Calibration data are given for metallic sheathed thermocouples made from Chromel A and 875 alloy. These data are given for application as a fuel element temperature sensor and as an air temperature. A brief description of the development effort is included. (auth)

10178 (DC-60-3-166) HALF-WAVE PUSH-PULL MAGNETIC VALVE DRIVE AMPLIFIER. S. F. Hemmenway (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 21, 1960. Contract AT(11-1)-171. 30p.

The design of a half-wave drive amplifier is described. Experimental results and temperature curves obtained by use of this instrument are shown. (J.R.D.)

10179 (DC-60-3-226) VOLTAGE AMPLIFIER ANALYSIS. D. B. Zeh (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 3, 1959. Contract AT(11-1)-171. 37p.

An analysis and 704 program used to obtain the complex transfer function of a general, one-stage, resistance-capacitance coupled, voltage amplifier are described. (auth)

10180 (DC-60-4-171) EVALUATION OF IONIZATION CHAMBERS FOR OPERATION AT 350°C. John E. Schroeder and Robert L. Treinen (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 27, 1960. Contract AT(11-1)-171. 12p.

Results of testing ionization chambers and component parts to a temperature of 350°C are presented. The limitations imposed upon ionization chamber operation at 350°C are discussed and some recommendations for reliable operation are offered. (auth)

10181 (DC-60-5-45) INDUCED THERMAL ERROR FOR THERMOCOUPLES ATTACHED TO THIN PLATES. R. A. Boudreaux (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 9, 1960. Contract AT(11-1)-171. 96p.

An analytical procedure was developed for determining the induced thermal error for a number of configurations of thermocouples attached to thin plates. Generalized plots for quick estimates of induced error are provided for several special cases. Included also are numerous examples to demonstrate the various error prediction methods. (auth)

10182 (DC 60-6-712) A COMPARISON OF COMMERCIAL TRANSISTORIZED FLIP-FLOP UNITS. E. J. Clerkin (General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho). June 6, 1960. Contract AT(11-1)-171. 19p.

An investigation was conducted on nine separate transistorized flip-flop units in an attempt to standardize units for current and future design at the Idaho Test Station, and provide a guide-line for procurement of commercial transistorized flip-flop units. It was found that standardization and interchangeability of transistorized flip-flop units are impractical because of the wide variation in electrical and mechanical characteristics between units. (auth)

10183 (DC-60-7-706) LOW LEVEL ION CHAMBER READER. R. W. Hyndman and W. G. Markland (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 21, 1960. Contract AT(11-1)-171. 14p.

A low level pocket dosimeter reader is described which was designed for low level discharge reading output proportional to the radiation exposure. The circuits, operating procedure, and pencil selection, and care are discussed. (auth)

10184 (DC-60-12-26) CALCULATED RESPONSE FUNCTIONS OF GAMMA RAY SPECTROMETER. E. H. Brooks (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 1, 1960. Contract AT(11-1)-171. 50p.

A Monte Carlo program was used to calculate energy loss spectra in a NaI crystal 5 in. dia. × 7.25 in. long for a monoenergetic parallel beam of photons from 0.661 up to 11.7 Mev. An infinitely sharp energy resolution is assumed. From the energy loss spectra photofractions, interaction ratios and escape probabilities at the various energies are also obtained. (auth)

10185 (GACD-2495) HIGH-TEMPERATURE BROAD-BAND SEMICONDUCTORS. Quarterly Technical Summary Report, April 1, 1961–June 30, 1961. P. H. Miller, Jr. (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Aug. 16, 1961. Contract NObs-77144. 12p. (AD-266021)

Work done on the study and development of new semiconductor materials for thermoelectric generation at temperatures above 800°K is summarized. Graphs are presented for the thermoelectric properties of barium-doped and undoped cerium sulfide and of praseodymium sulfide. Work on p-type materials and electronic processes in rare earth sulfides is described. (D.L.C.)

10186 (IA-699) ORGANIC LIQUID SCINTILLATORS. PART III. THE QUANTUM YIELD OF FLUORESCENCE AND THE QUENCHING OF FLUORESCENCE BY OXYGEN. Adam Heller (Israel. Atomic Energy Commission, Tel Aviv). Sept. 1961. 11p.

Expressions for the quantum yield of fluorescence of aromatic hydrocarbons in benzene and alkylbenzenes were derived assuming zero internal quenching. These expressions indicate that the molecular quantum yield of fluorescence increases with the lifetime of the first excited singlet state of the solvent, the transition probabilities from the levels of the solute that correspond to the levels involved in the excitation of the solvent, and the increase in the degree of degeneracy in the solute levels corresponding to those involved in the excitation of the solvent. Minimum values of the molecular quantum yield of fluorescence of a group of aromatic hydrocarbons were computed at different concentrations of the solutes. The compounds with the highest values are p-divinylanthracene, perylene, p-quaterphenyl and p-terphenyl. The dimensions of the excited aggregates that are formed by scintillators are estimated from Basile's data for solutions of PBD in polyvinyltoluene. The number of monomer units per aggregate is about 1250 and the radius of interaction about 18 A. The quenching of fluorescence by O is explained by the existence of π electron level pairs of almost similar energy difference in the solvent and the solvent-oxygen complex, and by the short lifetime of the complex compared with that of the solvent. The latter results from the lower order of symmetry of the complex in comparison with that of the π electron system in benzene. (auth)

10187 (NBS-MON-27) BIBLIOGRAPHY OF TEMPERATURE MEASUREMENT, JANUARY 1953–JUNE 1960. Carl Halpern and Robert J. Moffat, comps. (National Bureau of Standards, Washington, D. C.). Apr. 6, 1961. 15p.

More than 500 references are presented in the field of temperature measurement. The references are arranged according to the type of instrument used. (D.L.C.)

10188 (NP-11314) THE INTERMITTENT THERMOMETER: A NEW TECHNIQUE FOR THE MEASUREMENT OF EXTREME TEMPERATURES. S. D. Raezer and H. L. Olsen (John Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). Dec. 1960. Contract NOrd-7386. 20p. (CM-985)

A technique is described by which the range of a thermocouple may be extended above its melting point. Its primary use is the measurement of the temperature of very hot flowing gases or plasmas. The device consists essentially of a thermocouple probe that is shuttled back and forth between a point in the gas stream and a water-cooled jacket. (auth)

10189 (ORO-482) FLEXIBLE GEIGER COUNTERS. Final Report. Harold G. Richter and Arthur S. Gillespie, Jr. (Research Triangle Inst., Durham, N. C. Isotope Development Lab.). July 31, 1961. Contract AT(40-1)-2513. 14p. (RTI-2513-T4-1)

Long flexible Geiger counters were constructed from materials such as certain vacuum cleaner hoses. The anode is maintained in an axial position during coiling of the counter by means of polystyrene or polyethylene spacer disks. The cathode is a wire spiraled on the outside of the counter. Pulse heights are smaller than those from a comparable metal-wall counter but are always above 50 millivolts when flowing Q-gas is used as a counting medium. Plateaus are exceptionally long and flat: a 2% per 100 volts slope over 1000 volts was observed in a ten-foot counter. Plateau characteristics are unaffected by whether the counter is coiled or straight. Counting rates in excess of 300,000 counts per minute with little coincidence loss can be observed in these counters because of the compartmented method of construction. High counting rates for long periods of time failed to produce deterioration of pulse height, plateau, or counting rate. Efficiency of these counters for detection of gamma rays is less than that of metal-cathode counters. In use as anti-coincidence coils, the flexible Geiger counters reduced background counting rates of a shielded counter by 2.5-fold. That an expected 10-fold reduction in background count was not observed is explained by observing that much of the shielded counter axis was exposed to cosmic rays. (auth)

10190 (PPAD-419F) DESIGN AND PROPERTIES OF A NEON FILLED SPARK CHAMBER IN A MAGNETIC FIELD. Maarten P. Heyn (Princeton–Pennsylvania Accelerator, Princeton, N. J.). May 1, 1961. Contract AT(30-1)-2137. 94p.

Thesis submitted to Princeton Univ., N. J.

A description is given of the design, construction, and operation of a 50-plate, 1-ft long spark chamber. Several physical aspects concerning results obtained are considered. (J.R.D.)

10191 (PPAD-435D) A SCINTILLATION CHAMBER–IMAGE INTENSIFIER BEAM PROFILE DETECTOR. J. R. Waters, G. T. Reynolds, D. B. Scarl, and R. A. Zdanis (Princeton–Pennsylvania Accelerator, Princeton, N. J.). Dec. 19, 1961. Contract AT(30-1)-2137. 27p.

A scintillation chamber was mounted on a single stage image intensifier which was lens coupled to an intensifier orthicon in a closed circuit television system. Charged particles entered the ends and travelled down the length of the filaments causing flashes of light which were amplified and displayed on the monitor kinescope. This system was used as a detector of weak secondary beams from an accelerator with considerable success. It facilitates the setting up, alignment, and focusing of such beams and is quicker and more efficient than other methods. Based on this trial, a system is described which would be suited for use with secondary beams from the Princeton-Pennsylvania Accelerator. (auth)

10192 (TID-14863) A CRYSTAL MONOCHROMATOR FOR NEUTRON SPECTROMETRY (thesis). Robert I. Schermer (Massachusetts Inst. of Tech., Cambridge). Oct. 1960. 258p.

Three effects of the instrument on the measured spectrum are considered in detail. These effects include those of collimators on neutron beams, neutron diffraction by crystals, and the formation of the instrumental resolution function. Particular emphasis is laid on a description of the process of secondary, or multiple, scattering in the crystal. (J.R.D.)

10193 (TID-14985) PROGRESS REPORT [ON IMAGE INTENSIFIER]. Wilfrid F. Niklas (Rauland Corp., Chicago). Jan. 25, 1962. Contract AT(11-1)-1058. 20p.

Progress is reported in the development of double-stage visible light image intensifiers. The coupling member consists in essence of a spherically curved thin glass plate carrying on its convex side settled cathodo-luminescent phosphor and on its concave side an S-11 photocathode. The preparation of the coupling member is described. Improvements were made in the resolution of settled cathodo-luminescent phosphor screens. Several envelopes for double-stage image intensifiers were assembled. One double-stage tube was processed and tested. Photographs of the assembly are included and test results are tabulated. The image on the output of the double-stage image intensifier obtained by projecting a standard test slide on the curved photocathode input produced an image that was asymmetrically distorted to some extent. (C.H.)

10194 (TID-15005) SAFETY MONITOR FOR A LIQUID METAL FUEL REACTOR. (Little (Arthur D.) Inc., Cambridge, Mass.). Sept. 3, 1958. For Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va. 115p. (ALI-C-61378).

A feasibility study was conducted on the use of neutron methods and the paramagnetic susceptibility method to monitor the reactivity of the liquid metal fuel reactor experiment and to initiate a signal in case of excess reactivity. A combination of the neutron absorption and multiplication methods is recommended, and a monitor design is given. The paramagnetic susceptibility method was found to be not feasible without a bypass or replacement of the ferromagnetic pipe material by another metal. (D.L.C.)

10195 (UCRL-6048-T) SILVER BROMIDE CRYSTAL SIZE DISTRIBUTION AS INFLUENCED BY GELATIN CONCENTRATION IN PRODUCING NUCLEAR EMULSION. Albert J. Oliver and Ishfaq Ahmad (California. Univ., Livermore. Lawrence Radiation Lab.). July 1, 1960. Contract [W-7405-Eng-48]. 14p.

Results are reported from an investigation of the relation between grain size and silver ion concentration during precipitation during the preparation of nuclear emulsions. Emphasis was placed on the reproducibility of precipitations, the function of gelatin concentration, and crystal size distribution during preparation. Data are presented graphically. (C.H.)

10196 (UCRL-10001) NOISE CONSIDERATIONS IN NUCLEAR PULSE AMPLIFIERS (thesis). Donald A. Landis (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 20, 1961. Contract W-7405-eng-48. 70p.

The effects of certain pulse-shaping networks on the signal-to-noise ratio of a nuclear pulse amplifier were considered. The shaping networks discussed are: equal RC-integrating and RC-differentiating time constant, single-delay-line clipper and RC integrator, and double-delay-line clipper and RC integrator. The effects of these networks on the signal, when high count rates and overload pulses are present, were also considered. Equations and curves were developed for the energy resolution (signal-to-noise ratio) and resolving time (related to the ability to operate at high counting rates) of the networks. Experimental results are shown for the energy resolution of the types of pulse-shaping networks considered. (auth)

10197 (WADC-TR-59-107(Pt.III)) A MASS SPECTROMETER SYSTEM FOR MATERIALS RESEARCH. PHASE III. Charles F. Robinson, Norton W. Bell, George D. Perkins, and Richard H. Small (Bell & Howell Research Center, Pasadena, Calif.). May 1961. Contract AF33(616)-5571. 62p.

A mass spectrometer system with a resolution of 1 part in 2,500 was developed for use in identification of trace impurities in solids, structural studies of high-molecular-weight materials, and identification of unknown materials by molecular weight measurements. Ion sources using spark, electron bombardment, and high-temperature crucible were adapted to the basic system and photographic plate, electrometer, and electron multiplier detectors were used. (D.L.C.)

10198 (AEC-tr-5004) AMPLIFIERS FOR AUTOMATIC TRACING OF ELECTROCHEMICAL POTENTIALS. N. I. Isaev and N. D. Tomashov. Translated by Lydia Venters (Argonne National Lab., Ill.) from Trudy Inst. Fiz. Khim., Akad. Nauk S.S.S.R., No. 7, 96-104(1959). 12p.

A nonequilibrium Wheatstone-bridge-type circuit is described for automatically recording electrochemical potentials. In uses in which commercial self-recording potentiometers are inadequate because of their low input resistance, the potentiometer output is connected to the input of a triode, tetrode, or other amplifying electron tube having an input resistance of 5 to 10^4 megohm. The high input resistance of the amplifying tube makes possible the accurate recording of the potential. (T.F.H.)

10199 (JPRS-12188) FOCUSING METHODS IN A SHORT FOCAL-LENGTH BETA SPECTROMETER. R. Nathe, J. Schintlmeister, H. Seidenfaden, and R. Weibrecht. Translated from Exptl. Tech. Physik, 9: 1-12(1961). 17p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20871.

10200 SCINTILLATION SPECTROMETER WITH AUTOMATIC RECORDING. A. Gelberg and M. Iovan (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 379-85(1961). (In Rumanian)

The apparatus includes an amplitude selector with one channel whose level increases in a continuous manner. The recording is done with the aid of an automatic potentiometer. (tr-auth)

10201 MASS SPECTROMETER OF THE OMEGATRON TYPE. George Băjeu, George Comsa, and Adrian Gelberg (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 427-34(1961). (In Rumanian)

The construction, operation, and results obtained with two Omegatrons of 6-and-8 mm radius are described. A resolution of 65 ($m < 30$) and a sensitivity of $S = 0.5$ Torr^{-1} were obtained for helium. The mass spectrum of residual gases in an installation evacuated by an oil diffusion pump to 1.8×10^{-7} Torr is given. (tr-auth)

10202 AMPLITUDE DIFFERENTIAL ANALYZER WITH IMPROVED RESOLUTION FOR A SINGLE CHANNEL. Victor Păpureanu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 625-30(1961). (In Rumanian)

A brief discussion is given of the operational principle of the analyzer, in which the construction as given in the literature is described. The experimental performances obtained in the laboratory and some modifications of the constructions which have resulted in improved performance are indicated. Moreover, a theoretical calculation is proposed which gives the justification both of the experimental observations and the modifications made. (tr-auth)

10203 CHARACTERISTICS OF THE NEUTRON SHUTTER WITH CURVED SLITS OF THE INSTITUTE OF ATOMIC PHYSICS OF BUCHAREST. H. Teutsch, N. Mateescu, P. Pirlogea, C. Rădulescu, P. Timiş, and V. Vasiliu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 667-74(1961). (In Rumanian)

The characteristics of the curved slit neutron shutter of the Institute of Atomic Physics for the thermal and cold neutron range are given. The results of the experimental determination of the physical parameters are reported. (tr-auth)

10204 RECOIL SCINTILLATION SPECTROMETER WITH TWO CRYSTALS. N. Martalogu, N. Scinteie, M. Molea, I. Neamu, and M. Ivaşcu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 693-706 (1961). (In Rumanian)

In order to study the neutron spectrum given by nuclear interactions, a two-crystal spectrometer was constructed using the neutron recoil in the analyzer crystal in coincidence with the same neutrons scattered elastically and converging on the detector crystal. The FEU-29 photomultiplier was used as analyzer detector and FEU-33 as neutron detector. The crystals were stilbene crystals (30 × 10 mm). The time resolution of the fast coincidence of the apparatus is controllable between 20 and 40 nsec, with an efficiency almost constant at 100%. The spectrometer was tested with a Po-α-Be source and the operation is shown schematically. The efficiency of the apparatus, calculated for the energy E_0 = 4 Mev, is 0.8×10^{-4} and its energy resolution is 10%. (tr-auth)

10205 THE INFLUENCE OF FOREIGN IONS ABSORBED ON AgBr MICROCRYSTALS UPON THE SENSITIVITY OF NUCLEAR EMULSIONS. M. Nicolae. Acad. rép. populaire Roumaine, Rev. phys., 6: 143-8(1961). (In English)

NIFKI K plates were soaked for 1 hr at 20°C in three series of aqueous solutions having pH from 1 to 10 (without uranyl ions), different concentrations of uranyl ions within the limits of pUO_2^{2+} = 0.097 to 3.7 at neutral pH, and different pH from 1 to 9 at constant concentrations of uranyl ions. The sensitivity of the emulsions was then measured after washing and developing. For pH 1 to 4 there is a desensitization effect. Above pH 8 there is a reversible growth of the sensitivity in the presence of the soaking substance. Uranyl solutions with concentrations higher than 0.2N decrease the sensitivity. The effect is to a large extent reversible. The mechanism responsible for the effects of the H^+, OH^-, and UO_2^{2+} ions is described. A method for the verification of the H^+ and OH^- mechanisms is given, and the test results indicate good agreement with the mechanism proposed. (J.S.R.)

10206 A SEARCH FOR INSTRUMENTAL EFFECTS IN THE MEASUREMENT OF ANGULAR DISTRIBUTIONS IN NUCLEAR EMULSIONS. D. Anghelescu, J. S. Auslaender, I. I. Georgescu, and A. Vogel (Polytechnical Inst., Bucharest). Acad. rep. populaire Roumaine, Rev. phys., 6: 259-63(1961). (In English)

For an angular distribution which is known to be actually isotropic, data on projected angles measured for >9000 tracks from α stars in NIKFI-R emulsions are perfectly compatible with isotropy. Hence, the absence of instrumental effects simulating a nonexisting lack of isotropy is inferred, as far as projected angle measurements are concerned. This fact is of importance in the discussion of emulsion angular data on π-μ decay at rest. Furthermore, the probable existence of an α-α angular correlation for Rn^{220} and Po^{216} is pointed out (~99% confidence limit). (auth)

10207 DETERMINATION OF THE SIZE DISTRIBUTION OF AEROSOLS BY MEANS OF THE GOETZ AEROSOL SPECTROMETER. A. Goetz (California Inst. of Tech., Pasadena) and O. Preining. Acta Phys. Austriaca, 14: 292-304(1961). (In German)

The aerosol spectrometer applies a high centrifugal acceleration to a continuous laminar flow of an aerosol and separates particles and gas. The particles are collected on an exchangeable foil. The point of deposition and the Stokes diameter of the particle are in such a connection that the distribution of the particles on the foil yields the size distribution of the aerosol while airborne. (auth)

10208 CONSIDERATIONS ON THE RECORDING OF COSMIC RADIATION WITH A COUNTER TELESCOPE. Herbert Oberguggenberger (Universität, Innsbruck, Austria). Acta Phys. Austriaca, 14: 313-16(1961). (In German)

For recording cosmic radiation oscillations at the Hafelekar Observatory, two ionization chambers and a counter telescope were used. A study was made to determine the extent to which data from the three apparatus might be expected to agree and what factors influence accuracy. The relationship between the intensity of the cosmic radiation and the measurement value, the effect of the γ background, the shower effect, and the directional sensitivity of the instruments were investigated. The principles used in the study of these four points are discussed, and the results show that at constant directional distribution of the cosmic radiation, all instruments have good linearity. With unknown changes in the γ radiation and the directional distribution, an uncertainty occurs which can amount to several thousandths. The measurement curve is blurred by statistical errors. In fine structure studies, only those deviations whose amplitudes are larger than 5 to 7% of the absolute value should be considered. An accurate agreement between counter telescope and ionization chambers is only to be expected on quiet days. (J.S.R.)

10209 AN IMPROVED APPARATUS FOR LIFE TIME MEASUREMENT. Peter Weinzierl (Österreichische Studiengesellschaft für Atomenergie G.m.b.H., Vienna). Acta Phys. Austriaca, 14: 324-7(1961). (In German)

An improved coincidence apparatus, using an organic crystal (probably stilbene) in which the γ quanta to be measured is scattered and a NaI crystal for the detection of the scattered quanta, was designed for measuring the periods of isomers from (n,γ) reactions. The principle of the apparatus is shown graphically and discussed. A block diagram of the electronic circuit is given. (J.S.R.)

10210 THE SIGNIFICANCE OF NANOSECOND TECHNOLOGY FOR NUCLEAR PHYSICS. Josef Schintlmeister and Franz Stary (Technische Universität, Dresden and Zentralinstitut für Kernphysik, Rossendorf bei Dresden). Acta Phys. Austriaca, 14: 358-95(1961). (In German)

A survey is given on the significance of high time resolution in nuclear physical measurements. Present measure-

ments on the lifetime of excited nuclear levels are described in detail and compared with theoretical predictions. The K prohibition for gamma transitions, which leads to very long lifetimes, is also treated. Delayed coincidence techniques in the nanosecond range are described, and the mode of coincidence circuit operation is indicated. In conclusion, four methods with which delayed coincidence measurements can be evaluated are treated. (J.S.R.)

10211 APPARATUS REVIEW: OPEN AIR ALPHA PARTICLE COUNTER. John W. Dewdney (Dartmouth Coll., Hanover, N. H.). Am. J. Phys., 30: 140-3(Feb. 1962).

The counter detects alpha passage by utilizing the dielectric breakdown of air subjected to a high potential gradient. Breakdown occurs whenever an alpha particle ionizes a path in the air between a wire grid and a plate. A small, visible spark jumps between the grid and plate, thus indicating the alpha passage. Negative pulses of 5000 v and 10 μ-sec duration may be obtained. The discrete nature of radioactive emissions may be demonstrated; with modifications, the device may be used for more quantitative observations. (L.N.N.)

10212 INSTRUMENTS CHECK RADIATION FROM REACTOR PIPING SYSTEMS. R. L. Seidel and S. L. Williams (General Electric Co., Schenectady, N. Y.). Atomics, 15: 5-8(Jan.-Feb.-Mar. 1962).

A non-destructive radiochemical method taking advantage of transistorized gamma pulse-height analyzers is developed by which the amount and nature of the radioactive deposits both long and short-lived on any system surface can be determined. Additional information such as system corrosion rates and corrosion product distribution in the system can be estimated from the data. (N.W.R.)

10213 CHANGING INSTRUMENTATION OF HIGH ENERGY PHYSICS. G. W. Hutchinson (Univ. of Southampton, Eng.). Brit. J. Appl. Phys., 13: 52-7(Feb. 1962).

The possibility is reviewed of using hodoscopes, spark chambers, and Cherenkov devices in combination for investigating complicated and unusual reactions of elementary particles at high energies. (auth)

10214 MEASUREMENT OF γ-RAY DIFFRACTION ANGLES TO ±0.02 SECOND OF ARC WITH A DOUBLE FLAT CRYSTAL SPECTROMETER. J. W. Knowles (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 40: 237-56(Feb. 1962). (AECL-1429)

An optical method for the precision determination of the relative angle between the diffraction planes of two crystals of a double flat crystal spectrometer is described. An angular precision, probable error ±0.02 sec, is achieved. Measurement of relative angles are made by reference to a standard ruled scale. Absolute angles are determined by combining these measurements with measurements of the optical geometry. Factors which influence the precision measurements are discussed. It is concluded that γ energies between 0.5 and 2 Mev can be compared with a precision of a few parts in 10^5. (auth)

10215 DIFFRACTION ANGLE MEASUREMENTS BEARING ON THE DEUTERIUM BINDING ENERGY AND ON THE X-UNIT-TO-MILLIANGSTROM CONVERSION CONSTANT. J. W. Knowles (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 40: 257-73(Feb. 1962). (AECL-1430)

Precise angle measurements of deuterium de-excitation and annihilation radiations were made using a double flat crystal diffraction spectrometer. The deuterium γ was diffracted from the (211), (211); (211), (633); (211), (844); and (844), (844) planes of two calcite crystals. The energy comparison, based on angle measurements of the deuterium γ diffracted from the (844), (844) and the annihilation γ from the (211), (211) planes of the two crystals, is particularly insensitive to systematic geometric error. If the energy and standard error of the annihilation radiation is taken to be 510.978 ± 0.007 kev, the deuterium binding energy is 2224.52 ± 0.20 kev. Absolute angles were measured for both diffracted γ. A knowledge of the absolute diffraction angle and the absolute wavelength of the annihilation γ determines the absolute spacing of the diffraction plane of calcite, d_{211} = 3035.70 ± 0.15 mÅ at 18°C. With reference to the standard d_{211} spacing of calcite, 3029.494 x-units, the conversion constant from x-unit to mÅ is 1.002049 ± 0.000057. (auth)

10216 STANDARDIZATION OF ELECTRONIC INSTRUMENTATION AND CONTROL SYSTEMS. J. G. Nish (Univ. of California, Livermore). Elec. Eng., 80: No. 2, 129-35(1961). (UCRL-5964)

The design and construction of elaborate electronic systems for instrumentation and control of test and research facilities is guided by principles and practices of standardization which reduce system cost and completion time. A summary of these standardization principles and practices is presented. (auth)

10217 A PROPORTIONAL CONTINUOUS RIVER AND STREAM WATER SAMPLER AT GEORGIA NUCLEAR LABORATORIES. J. M. Selby, J. R. Wright, B. M. Bowen, and J. H. Edgerton (Lockheed Aircraft Corp., Marietta, Ga.). Health Phys., 6: 149-51(Oct. 1961).

The main facility at the Georgia Nuclear Laboratories (GNL) is an air-shielded 10 Mw reactor designed for a high leakage flux. This reactor, located within 750 ft of the Etowah River, is used for irradiation of aircraft systems and components. Because of the high neutron dose and the resultant soil activation, rigid control is maintained on run-off streams and the Etowah River. In order to overcome the lack of power at river and stream sampling sites, a sampler was designed to utilize river power. The sampler, built on the water wheel principle, includes an adjustable suction device and a revolution counter. Using a current measuring apparatus, such as a Gurley meter, and maintaining the sampler at a desired sampling rate, the total revolutions and the volume collected can be related to the rate of flow of the river. The construction of the continuous proportional water sampler and the calibration are discussed. (auth)

10218 OPERATIONAL EXPERIENCE WITH KANNE IONIZATION CHAMBERS. J. E. Hoy (E. I. du Pont de Nemours & Co., Aiken, S. C.). Health Phys., 6: 203-10 (Oct. 1961).

Operating experience with two types of Kanne ionization chambers is described. These chambers are used to monitor gaseous radioactive β-emitting contaminants released during the operation of heavy-water moderated reactors at the Savannah River Plant. Calibration results, γ-sensitivity, the effects of β-energy on chamber sensitivity, and the effects of such variables as temperature, pressure, and humidity on the operating characteristics of these chambers are discussed. (auth)

10219 MEASUREMENTS OF FAST NEUTRON FLUX BY MEANS OF ACTIVATION OF PHOSPHORUS. A. H. W. Aten, Jr., E. J. de Haan, and W. M. C. de Jong (Instituut voor Kernphysisch, Amsterdam). Health Phys., 6: 211 (Oct. 1961).

A method for the measurement of fast neutron flux by

phosphorus activation is described. Twenty g of red phosphorus is first evaporated from a large size porcelain boat in a current of nitrogen and the vapor is burned in the flame of a Bunsen burner. During the evaporation, the temperature is raised from about 500 to 600°C and, after the phosphorus has disappeared, the temperature is raised to 750 to 800°C, depending on the kind of phosphorus used. The sensitivity of the method depends largely on the ash-content of the phosphorus. A complication is presented by the fact that red phosphorus always contains a measurable quantity of radioactivity. If the best quality phosphorus is used it is possible to detect a continuous flux of fast neutrons (E > 2 Mev) around 20 n/cm^2 sec or a single burst around 3×10^5 n/cm^2. The method has the advantages of being equally sensitive to pulsed neutrons and to a constant flux and of not being disturbed by the presence of γ rays. (P.C.H.)

10220 A BROAD-RANGE CHEMICAL DOSIMETER. Nathan Klein (Nuclear Defense Lab., Army Chemical Center, Md.). Health Phys., 6: 212-14(Oct. 1961).

A study was made of saturated aqueous solutions of benzene as a broad-range chemical dosimeter. The incorporation of a highly sensitive analytical procedure for the determination of phenol with the radiolysis of benzene is described. The sensitivity of the system was found to be quite good. Conventional care in the preparation of the benzene solutions and in conducting the analysis permits a measurement of dose with a precision of ±10%. (P.C.H.)

10221 INSTRUMENTS FOR CIVIL DEFENSE. Robert B. Martin (Office of Civil and Defense Mobilization, Battle Creek, Mich.). Health Phys., 6: 216-17(Oct. 1961).

Discussion is given on the types of instruments developed and purchased by the Office of Civil and Defense Mobilization (OCDM) since 1952 for the use of organized civil defense at all government levels. Particular attention is given to dosimeters and survey meters. A brief outline of the future plans of the OCDM is also given. (P.C.H.)

10222 MEASUREMENT OF BONE-MARROW DOSE IN A HUMAN PHANTOM FOR Co^{60} γ-RAYS AND LOW-ENERGY X-RAYS. R. Wilson and J. A. Carruthers (Defence Research Chemical Labs., Ottawa). Health Phys., 7: 171-7(Feb. 1962).

A phantom of the thoracic and upper abdominal section of the body was constructed of mix D wax with lateral and sagittal dimensions 30 and 23.5 cm, respectively. All bones lying between T1 and L2 were inserted. The bones were filled with D wax in a vacuum oven. Lung tissue was simulated by a cork and wax mixture of 0.3 gm/ml density. Measurements were made of the bone marrow dose for various energies of x radiation and Co^{60} γ radiation, using a standardized irradiation procedure. A chemical dosimeter system was used. Data are tabulated. The effects of the shielding of the marrow by the bone structure and the enhancement of dose in the marrow which is close to the bone structure on bone marrow dose are discussed. (C.H.)

10223 MIXED RADIATION DOSIMETRY OF A PLUTONIUM–BERYLLIUM NEUTRON SOURCE. Donald C. Lawrence (Hazelton-Nuclear Science Corp., Palo Alto, Calif.). Health Phys., 7: 179-84(Feb. 1962).

The dose rate delivered to an assumed standard tissue by the fast-neutron and γ-radiation from a standard 1 c plutonium–beryllium neutron source was determined by measurements with ethylene-filled polyethylene and CO_2-filled Teflon ionization chambers. The resulting ionization currents as measured with a calibrated vibrating-reed electrometer were used to obtain a measure of both the γ- and fast-neutron components of the emitted radiation. The tissue dose rate due to the fast neutron extrapolated to 1 cm from the source was found to be 1.74 rads/hr. The γ-component was found to contribute 0.16 rad/hr. From the neutron dose rate and the neutron spectrum for Pu–Be, the emission rate of the source was calculated to be 1.65×10^6 neutrons/sec-c. A discussion of the neutron and γ-spectra of the emitted radiation from this source and some aspects of ionization chamber design are also included in this report. (auth)

10224 IMPROVED MEMBRANE-FILTER AIR-SAMPLING METHODS FOR ENVIRONMENTAL CONTROL. K. J. Schiager, T. M. Allen, S. B. Gerber, G. E. Kinsella, F. J. Krupka, and D. W. Reilly (Argonne National Lab., Ill.). Health Phys., 7: 185-90(Feb. 1962).

Air sampling is a useful tool for controlling, as well as for analyzing, the environment. The equipment and techniques described were designed to facilitate the collection of localized samples directly at the source of potential contamination. Routine use of membrane filters was simplified by the design of a small, inexpensive filter holder, providing advantages over commerically available units, e.g. reduced size and weight, tight sealing against any filter material without the twist-lock action which often damages filter membranes, and parts exposed to contamination are expendable. Techniques for determining sample collection rates directly from vacuum-gauge readings are described. A combination α-γ scintillation detector assembly, designed specifically for counting membrane-filter samples, was constructed. Sample preparation techniques for use with internal proportional counters are also mentioned. (auth)

10225 A FIRST REPORT ON THE MANUFACTURE OF γ-RAY GEIGER COUNTERS. Heng-Yueh Li, Wen-Hwei Chang, and Wei-Ching Ling. Ho Tsu K'o Hsueh, 1: No. 4, 28-39(1957). (In Chinese)

Geiger counters with characteristics similar to U. S.-made Tracerlab SU–3C with TGC–1 tubes and Tracerlab Su–3CTW with TGC–2 tubes are produced with essentially local raw materials. The process of manufacture is outlined. The conventional c/m vs. V plot for the local Geiger tubes show a plateau of 200–300 volts. The circuits for using microammeter as indicator as well as that for using earphones are given. The effect of the nature of the cathode surface was studied in some detail. A table was also given in which the costs were compared with the American products. (TTT)

10226 THE TECHNOLOGY OF ELECTRON TUBES IN THE ATOMIC INDUSTRY. Harry Huber (Compagnie Generale de Telegraphie Sans Fil (C.S.F.), Orsay, France). Inds. atomiques, 5: No. 9-10, 85-97(1961). (In French)

Beginning with the techniques and the methods developed during the last few years as a result of the requirements of the hyperfrequency tubes, some of the technological methods used are reviewed. The methods selected are connected to the problem of ultravacuum. Metal-metal bonding by welding, metal-ceramic bonding, pumping and maintenance of the ultravacuum by titanium pumps, measurement of vacuum, and the analysis of the residual gas with the Omegatron are reviewed. (tr-auth)

10227 THE LOG COUNT RATE PERIOD METER USED WITH SAFETY CIRCUITS. Helge Christensen (Royal Norwegian Council for Industrial and Scientific Research, Oslo) and Robert B. Stanfield. IRE Intern. Conv. Record, 9: Pt. 9, 3-7(1961).

Equations are presented that give the probable rate of spurious reactor scrams due to counter noise in the period circuits commonly used at low reactor power. It is shown how a filter introduced to reduce the spurious scram rate, will delay the circuit response in the case of true emergencies. A numerical example shows that a compromise can be reached that gives a very satisfactory circuit. (auth)

10228 PROPORTIONAL CONTROL OF PRESSURIZED WATER REACTORS. Donald E. Rathbone (Univ. of Pittsburgh). IRE Intern. Conv. Record, 9: Pt. 9, 31-7(1961).

An investigation of the transient behavior of a pressure tube reactor indicated a definite need for external control to handle even normal load perturbations. Three proportional controllers were developed which were effective in containing the transients of the system for changes in load. A comparison of the three controllers indicated little preference between them with regards to variations in reactor power, primary loop temperature, or system pressure. The final selection of a controller was thus an economic consideration. (auth)

10229 TRANSIENT EFFECTS OF PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS AND MATERIALS. H. J. Degenhart and W. Schlosser (Army Signal Research and Development Lab., Fort Monmouth, N. J.). IRE Intern. Conv. Record, 9: Pt. 9, 38-51(1961).

Radiation induced transient changes in the electrical characteristics of electronic parts and materials obtained in recent experiments at the GODIVA II pulse reactor are described and discussed. The electronic parts investigated and monitored during exposure include: coaxial cables; resistors, various types and manufacture, ranging in value from 100 ohm to 1 megohm; sensistors; capacitors, ceramic and tantalum; rectifiers, silicon and selenium; and magnetic cores, ferrite. Most of the parts during exposure show transient parameter changes which exceed the tolerance values and then recover generally to the nominal value within two to five milliseconds. This behavior is of serious concern in data and information processing equipment and in high frequency and high accuracy instrumentation which must maintain operational tolerance even for short periods. (auth)

10230 PROBLEMS OF TESTING MILITARY COMPUTERS AND COMPUTER COMPONENTS IN NUCLEAR RADIATION ENVIRONMENTS. Alton L. Long and Paul E. Brown (Burroughs Labs. and Great Valley Lab., Paoli, Penna.). IRE Intern. Conv. Record, 9: Pt. 9, 52-5(1961).

The need is demonstrated for testing computers and components in radiation to insure their effective performance in service. It is shown that simulation of environments poses problems because of differences in radiation sources and the difficulties of using them effectively. The ideal testing program defines its objectives in terms of improving resistance to radiation and finding adequate grounds for predicting effective computer life. The test plan considers the kind and quantity of specimens, the electrical conditions of testing, and the choice of facilities. The difficulties of obtaining accurate measurements of nuclear and non-nuclear environmental variables and of electrical parameters in a radiation field are reviewed. The value of a computer for data handling and the problems of reporting are discussed. (auth)

10231 FOUR CHANNEL MAGNETIC TAPE SYSTEM FOR MEDICAL STUDIES. R. Hindel (Atomium Corp., Waltham, Mass.) and G. J. Hine. IRE Intern. Conv. Record, 9: Pt. 9, 56-66(1961).

A four channel gamma ray scintillation detection system which uses a four track, four speed magnetic tape recorder as data storage device and a linear, a logarithmic, and a ratio ratemeter as output devices is described. The clinical application of this system and its performance are discussed. (auth)

10232 AUTOMATIC SAMPLE HANDLING AND PROCESSING OF NUCLEAR DATA. G. M. Kerrigan, L. E. Babcock, and D. Forrant (Tracerlab, Inc., Waltham, Mass.). IRE Intern. Conv. Record, 9: Pt. 9, 75-8(1961).

With the increased use of radioisotopes in the medical and biological fields in research, as well as diagnostic and therapeutic work, it has become necessary to supply the users with automatic equipment for handling samples and more sophisticated equipment for handling the information. The basic problems and a typical system are described. (auth)

10233 THE DESIGN OF REGULATED, MINIATURE HIGH VOLTAGE D.C. POWER SUPPLIES FOR SATELLITE AND DEEP SPACE PROBE APPLICATIONS. Jerry B. Minter (Components Corp., Denville, N. J.). IRE Intern. Conv. Record, 9: Pt. 9, 79-86(1961).

Some of the problems associated with the design of miniature high voltage power supplies for operation of radiation measuring devices such as scintillation counters, Geiger-Mueller counters, BF_3 counter tubes, etc., are discussed. Most of the Geiger tubes and BF_3 tubes have adequate plateau by virtue of their design to permit the use of rather poorly regulated high voltage supplies. It is common practice to use gaseous glow or corona type regulators where additional regulation is required. Such brute force type regulators consume considerable power and leave much to be desired as to stability under a wide range of environmental conditions such as might be encountered in a satellite or deep space probe. Where it is necessary to provide continuous adjustment of the high voltage in addition to precise regulation, in order to calibrate the over-all sensitivity of the photomultiplier, the use of fixed corona type regulators becomes impractical. (auth)

10234 A NEW INSTRUMENT FOR DIFFERENTIAL DME POLAROGRAPHY. S. Rankowitz, W. A. Higinbotham, and J. Glickstein (Brookhaven National Lab., Upton, N. Y.). IRE Intern. Conv. Record, 9: Pt. 9, 87-96(1961). (BNL-5315)

A new approach to instrumentation for dropping mercury polarography is developed. The dropping mercury electrode (DME) current is converted to a voltage by a d-c negative feedback amplifier. The output of this amplifier is sampled at a fixed delay after the drop fall. The value of each sample is stored on a capacitor and successive differences are taken by a simple switching arrangement. The instrument includes a precise potential supply for the polarographic cell which may be used for scanning or location of the half wave potential. Drop fall is detected by the change in an r-f signal, and accurate timing circuits control the sampling and display. (auth)

10235 A NUCLEAR REACTOR REGULATING ROD POSITION INDICATOR. R. I. Little (Phillips Petroleum Co., Idaho Falls, Idaho). IRE Intern. Conv. Record, 9: Pt. 9, 8-14(1961).

Some of the aspects to the problem of regulating rod position indication in the Advanced Reactivity Measurement Facility now in operation at the National Reactor Testing Station are discussed. The solution, a system employing a high resolution shaft angle digitizer and solid state digital and analog circuitry, is described. The system's capabilities and shortcomings are reviewed. (auth)

10236 COUNTER FOR ATMOSPHERIC IONS. N. N. Komarov, M. D. Kuz'menko, and A. A. Seredkin (Inst. of Applied Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 12: 1875-81(Dec. 1961). (In Russian)

Descriptions are given of the design and operation of a portable counter for measuring light and heavy ions in the atmosphere near the Earth's surface. The counter is also efficient under laboratory conditions in measuring the density and motion of artificial atmospheres. (R.V.J.)

10237 EFFICIENCY OF A GEIGER-MUELLER TUBE FOR NON-PENETRATING ELECTRONS. Louis A. Frank (California Inst. of Tech., Pasadena). J. Franklin Inst., 273: 91-106(Feb. 1962).

The efficiency for the detection of non-penetrating electrons of a Geiger-Mueller tube, specifically an Anton No. 302, was investigated in several physical situations in the energy range of 15 to 125 kev. The experimental results were applied to examples in which the tube was encased in a closed shell which served as the electron target in a region of an omnidirectional electron flux. This investigation serves as a basis for the quantitative determination of electron fluxes via the intermediate electron bremsstrahlung process with a Geiger-Mueller tube. (auth)

10238 PROTON RECOIL NEUTRON SPECTROMETER USING A LIQUID HYDROGEN RADIATOR AND A CsI(Tl). Shigeo Takemoto and Yukio Hiratate (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 17: 245(Jan. 1962). (In English)

Efficiencies of polyethylene and liquid hydrogen radiators are determined and compared for 14-Mev protons. The liquid hydrogen radiator efficiency is about 13 times as great as that of the polyethylene. The recoil proton spectrum was measured using a single-channel pulse-height analyzer and α monitor. Experimental data agree with theoretical calculations. A diagram of the neutron spectrometer is presented. (L.N.N.)

10239 STORAGE OSCILLOSCOPE USED IN CONJUNCTION WITH THE SCANNING ELECTRON PROBE MICRO-ANALYSER. G. V. T. Ranzetta and V. D. Scott (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Sci. Instr., 39: 50-3(Feb. 1962).

The value of a Remscope storage oscilloscope as an accessory to a Cambridge scanning microanalyser is assessed, using widely different test specimens. It is concluded that although the storage tube does not replace the existing method for obtaining x-ray pictures suitable for reproduction purposes, it is nevertheless a useful aid for judging the desired photographic exposure times and the appropriate magnification for a particular field of view. The most important facility the device offers is considered to be that for positioning the electron probe with direct reference to the x-ray image, thereby allowing point analysis of a particular microstructural feature to be carried out with a greater consistency than was previously possible. (auth)

10240 "SCINTIGRAPH"—AN APPARATUS FOR GRAPHIC REGISTRATION OF GAMMA-RADIATION. V. Kh. Kogan and A. N. Semikolennykh (Yaroslavl Medical Inst., USSR). Med. Radiol., 6: No. 12, 56-8 (Dec. 1961). (In Russian)

The portable apparatus is intended for graphic registration of the distribution of a γ-emitting isotope in the thyroid gland. A scintillation counter screened with lead was utilized as a recorder. (auth)

10241 GAMMA-RAY SPECTRUM OBTAINED WITH A LITHIUM-DRIFTED p-i-n JUNCTION IN GERMANIUM. D. V. Freck and J. Wakefield (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). Nature, 193: 669(Feb. 17, 1962).

The pulse-height spectrum from a lithium-drifted p-i-n junction in germanium due to 663-kev gamma rays from cesium-137 is presented. The photopeak exhibits a line width of 21 kev giving a resolution of 3.2 per cent. The height of the photopeak is about one-third that of the edge of the Compton distribution. The ratio of the pulse heights at the photopeak and the point half-way up the Compton edge differed from the theoretical value by less than 4 per cent. (N.W.R.)

10242 SEMICONDUCTOR COUNTERS FOR ATOMIC RADIATION. R. B. Owen (Atomic Energy Research Establishment, Harwell, Berks, Eng.). New Scientist, 13: 326-8 (Feb. 8, 1962).

The operation and performance of semiconductor detectors is discussed. The results show that the detectors are superior in some ways to gas and scintillation counters yet more limited in others. Information is given on the different types of crystalline material used, pulse formation in semiconductors, recombination and trapping in the detectors, and the characteristics of the various types (junction, lithium drifted junction, and high-gap detectors). (N.W.R.)

10243 AIRBORNE GAMMA MONITOR FOR GROUND CONTAMINATION. Alun R. Jones (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucleonics, 20: No. 3, 66-9(Mar. 1962).

An airborne gamma survey monitor utilizing a sodium-iodide scintillometer is described for detecting and measuring ground contamination. The monitor is suitable for use in cases where isotopes are released accidentally to the atmosphere or where the area is large and foot or road travel is difficult. Circuit diagrams are presented for the amplifier and counting-rate circuit. The method used in calibrating the monitor is described and the performance is illustrated. (N.W.R.)

10244 PINHOLE CAMERA LOCATES SOURCES OF GAMMA RADIATION. Lyman L. Wiltshire (Naval Radiological Defense Lab., San Francisco). Nucleonics, 20: No. 3, 76(Mar. 1962).

The design and operation of a small pinhole camera made of lead to locate unknown sources of gamma radiation in hot-cell work are described. An exposure is first made with x-ray film and then, without moving the camera, an exposure is made with ordinary black and white film. Superposition of the gamma-ray photograph on the ordinary photograph automatically locates any radiation hot spots in the area photographed. The equation used for calculating the pinhole, which is crucial to the design, is given. The performance of the camera is illustrated. (N.W.R.)

10245 LOW-COUNTING-RATE ERRORS FROM PHOTOMULTIPLIER FATIGUE. J. F. Reid, W. E. Baker, and D. M. Compton (International Business Machines Corp., Yorktown Heights, N. Y.). Nucleonics, 20: No. 3, 80; 82 (Mar. 1962).

Results show that phototube fatigue can introduce a large unsuspected error at apparently low counting rates. However, photomultiplier fatigue, the change in phototube gain caused by excessive exposure to light, can be avoided through suitable precautions. It is shown that errors arise in some situations for counting rates as low as about 10000 cpm. Thus, to make accurate measurements of counting rate one usually counts a standard at intervals to detect and correct for any drift in the scintillation spectrometer.

Two practical examples are given that illustrate the errors of fatigue. (N.W.R.)

10246 MAGNETIC COIL TELLS WHEN CONTROL ROD SEATS. Wayne E. Williams and Frederick J. Shon (Univ. of California, Livermore). Nucleonics, 20: No. 3, 92(Mar. 1962).

A magnetic-coil sensor is described along with the method used for measuring both release time and total drop time simultaneously. The sensor fastens to a split tube that will fit around a magnet guide tube. The sensor is illustrated by the results obtained from tests made in the Livermore Pool Type Reactor. The circuit used for measuring control-rod drop times is illustrated. The release time and total drop time for the Livermore reactor is given as it is measured on a dual-beam oscilloscope. (N.W.R.)

10247 THE TRACK DENSITY OF A CHARGED PARTICLE IN A PHOTOGRAPHIC EMULSION. C. Candler (South Australian Inst. of Tech., Adelaide). Nuovo cimento (10), 21: Suppl. No. 1, 1-6(1961). (In English)

In the track formed by a charged particle passing through a photographic emulsion, the curve relating the number of grains per unit length dN/dR to the rate of energy loss dE/dR is important. R is the residual range, and dN/dR is commonly written g. Hitherto based on experiment alone, this curve is shown to fit the equation of a photographic monolayer, $(sdE/dR)^P = g/(g_s - g)$. Here g_s is the linear saturation density, P the photon number and s the reaction cross section of a silver halide crystal. Experiment shows that P differs little from unity. The characteristic of a plate exposed to a large number of α-particles fits the Poisson equation $D/D_s = I - \exp[-sE]$. This equation is accepted but not easily explained. (auth)

10248 OPTICAL MEASUREMENTS ON NEON FLASH-TUBES. H. Coxell, M. A. Meyer, P. S. Scull, and A. W. Wolfendale (Univ. of Durham, Eng.). Nuovo cimento (10), 21: Suppl. No. 1, 7-20(1961). (In English)

The light output from neon flash tubes traversed by ionizing particles was studied under a wide range of experimental conditions. It is shown that there is sufficient reproducibility in the intensity of the light output of the tubes in an array for accurate estimates to be made of the number of tubes flashing from the total amount of light emitted. An application is in the study of cosmic showers (extensive air showers); the need to photograph the array of flash tubes is removed and the recording of a single pulse from a photomultiplier system is substituted. When used in conjunction with after-flashing the photomultiplier method can be used to give an array of flash tubes some measure of internal selection of events. (auth)

10249 ON THE APPLICATION OF THE NUCLEAR EMULSION TECHNIQUE TO THE STUDY OF COMPLEX ELECTRON CONVERSION SPECTRA. A. M. Cartacci, M. G. Dagliana, and L. Tocci (Istituto Nazionale di Fisica Nucleare, Florence and Università, Florence). Nuovo cimento (10), 21: Suppl. No. 1, 21-8(1961). (In English)

In an investigation of (n,p) reactions with Ag and Br in nuclear emulsion, energy measurements on the slow conversion electrons were made by blob counting and range determination. The method is capable of yielding energy values with an uncertainty of ±5% for single measurements. Results on the (n,p) reactions with Ag and Br are also reported. These reactions were identified by their typical appearance in emulsions. Angular distributions of the emerging protons are given; a forward collimation is evident also if restricts to the Ag or Br (n,p) reactions are made. (auth)

10250 PHOTOMETRY OF RELATIVISTIC HEAVY NUCLEI. M. G. Dagliana, M. Della Corte, and L. Tocci-Cecchi (Istituto Nazionale di Fisica Nucleare, Florence and Università, Arcetri (Florence)). Nuovo cimento (10), 21: Suppl. No. 1, 29-38(1961). (In Italian)

The photometric profile of the tracks of relativistic heavy nuclei in nuclear emulsions was studied. A model for the track is developed according to which the track is made up of a central part of grains directly affected by the heavy nuclei and a peripheral part in which the darkening is due to the secondary electrons. The experimental results are in accord with this model. By measuring the darkening at a distance of more than 3.5 μm from the axis of the track, a method is proposed for the identification of the charge Z of the heavy nuclei. This method appears to compete favorably with other standard methods. The possibility of using the half width as a parameter for the identification of the charge of heavy nuclei is also discussed. (auth)

10251 A 60° SECTOR TYPE ELECTROMAGNETIC ISOTOPE SEPARATOR. F. Bisi, A. Cattoni, B. De Michelis, and P. Piechele (Istituto di Fisica del Politecnico, Milan). Nuovo cimento (10), 21: Suppl. No. 1, 39-47(1961). (In English)

A 60° sector type electromagnetic isotope separator is described. The separator produces ion current of the order of ma, in the range of light and intermediate masses. Results of experimental separations, carried out using Zn and Mg are also reported. (auth)

10252 A STUDY OF UNIFORM ISOTHERMAL PROCESSING OF NUCLEAR EMULSIONS. D. Kniffen (Washington Univ., St. Louis). Nuovo cimento (10), 21: Suppl. No. 1, 55-68(1961). (In English)

Nuclear emulsions exposed to a 1.86-Bev/c positive particle beam were developed. An isothermal procedure at 10°C gives satisfactory uniformity of development with depth. Data are also presented on the grain size, background grain density, and distortion for the different methods used. (auth)

10253 WAVEFORMS AND PULSE-HEIGHT DISTRIBUTIONS OF THE GRID PULSES FROM GRIDDED IONIZATION CHAMBERS. I. Ogawa (Rikkyo Univ., Tokyo). Nuovo cimento (10), 21: Suppl. No. 1, 69-86(1961). (In English)

An improved pulse-height formula for the grid pulses from a gridded ionization chamber is derived on the basis of a waveform analysis. It is found that the original formula proposed by Bochagov et al. (Isv. Akad. Nauk SSSR, Ser. Fiz., 20: 1455(1956); Zh. Tekhn. Fiz., 27: 1575(1957)) becomes insufficient for an accurate work, when the drift time t_2 of electrons in the grid-collector space is not negligible in respect to the drift time t_1 in the cathode-grid space. It is shown that the negative pulse-height of grid pulses due to particles emitted from the collector or the grid is very small compared to those due to particles from the cathode, provided that $t_2 \ll t_1$. Distortion in pulse-height distributions, caused by the finite thickness of the source as well as by the finite band-width of the amplifier, is also investigated analytically. (auth)

10254 SCINTILLATION SPECTROMETER WITH REDUCTION OF THE COMPTON CONTRIBUTION. C. Manduchi, G. Nardelli, and M. T. Russo-Manduchi (Instituto Nazionale di Fisica Nucleare, Padua and Università, Padua). Nuovo cimento (10), 21: Suppl. No. 1, 87-93(1961). (In Italian)

A spectrometer was designed in which a small NaI(Tl)

crystal is surrounded by a large plastic phosphor: the output from the crystal is put in anticoincidence with the output from the plastic. This system reduces the Compton contribution in the scintillation spectrum and enables spectral features to be identified. (auth)

10255 A FISSION CHAMBER FOR INTENSITY CONTROL IN A COLLIMATED NEUTRON BEAM. G. P. Felcher, F. Gazzarrini, and G. Poletti (Laboratori C.I.S.E., Segrate (Milan)). Nuovo cimento (10), 21: Suppl. No. 1, 94-100(1961). (In Italian)

A thin layer fission chamber, to be used as a monitor in a collimated slow neutron beam from a reactor, is described. The influence of the pressure of the filling gas and of the voltage is discussed. A description of the electrodeposition of thin layers of uranium is given. (auth)

10256 SM 59 SCINTILLATION MEASURING EQUIPMENT. Gerhard Schubert, Dieter Hempel, and Guenter Roemer. Radio u. Fernsehen, No. 23, 752-9(1960).

The SM 59 measuring equipment for γ spectroscopy is described. It consists of measuring head, linear amplifier, single-channel amplitude analyzer, pulse-density measuring device, recorder, and high-voltage generator. The pulse amplication factor is 10^5 to 10^7. Formation of the voltage impulses at the resistance connected to the anode and the impulse shape are described. Circuit diagrams and functions of the other complimentary equipment are also described. (OTS)

10257 DATA ON IONIZATION INCREASE IN 0.1- TO 5-l RADON-FILLED CHAMBERS. N. P. Kartashov. Radiokhimiya, 3: 637-8(1961). (In Russian)

Ionization-increase measurements were made on ionization chamber, considering geometrical and volume parameters. It was confirmed that under identical conditions the magnitude of the relative ionization depends on the volume of the chamber. (R.V.J.)

10258 NEW INSTRUMENTS FOR RECORDING THE INSTANT OF EXPLOSIONS. Yu. V. Khomenyuk. Vsesoyuz. Nauch.-Issledovatel'. Inst. Geofiz. Metodov Razvedki. Razved. i Promyslov. Geofiz., No. 37, 42-6(1960).

Two instruments, the OMB-1 and the TB-7, for receiving and transmitting by radio the instant of an explosion were developed. Both recorders can be easily connected to radio transmitters and fed from the same power sources as the latter. A galvanometer for instantaneous registration records the signal at a frequency of 400 cps; at the instant of explosion this signal cuts off abruptly. The combined action of an amplitude limiter and a narrow-band amplifier insures that the equipment is highly accurate and noiseproof. The error in signal transmission does not exceed 0.002 sec. Neither recorder exceeds 140 × 180 × 200 mm in size or 5 kg in weight. (OTS)

10259 MEASURING METHOD FOR SPHERICAL SPECIMEN RADIOACTIVITY. V. V. Moiseev (Inst. of Silicate Chemistry, Academy of Sciences, USSR). Zavodskaya Lab., 27: 1369-71(1961). (In Russian)

A method was developed for measuring the radioactivity of spherical specimens and in determining the ion exchange properties of electrode glass. (R.V.J.)

10260 DIMENSION STABILIZED FIXED PHOTOGRAPHIC TYPE EMULSION AND A METHOD FOR PRODUCING SAME. Francis C. Gilbert (to U. S. Atomic Energy Commission). U. S. Patent 3,025,162. Mar. 13, 1962.

A process is given for stabilizing the dimensions of fixed gelatin-base photographic type emulsions containing silver halide, and particularly to such emulsions containing large amounts of silver chloride for use as nuclear track emulsions, so that the dimensions of the final product are the same as, or in a predetermined fixed ratio to the dimensions of the emulsions prior to exposure. The process comprises contacting an exposed, fixed emulsion with a solution of wood rosin dissolved in ethyl alcohol for times corresponding to the dimensions desired, and thereafter permitting the alcohol to evaporate. (AEC)

Materials Testing

10261 (APEX-656) PRE-TEST PREDICTIONS. T. E. Sicking (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Aug. 31, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 7p.

A procedure for gathering as much information as possible in tests in as short a period of time as possible by pre-test predictions is discussed. The philosophy, formal procedure, and advantages of this method are outlined. (M.C.G.)

10262 (HW-70919) A NONDESTRUCTIVE TEST FOR DETERMINING GRAIN SIZE AND UNIFORMITY IN MASSIVE URANIUM FUEL CORES. G. L. Waldkoetter (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1, 1961. Contract [AT(45-1)-1350. 24p.

For presentation at the Fourteenth Joint U.S.-Canadian Sheath Program Meeting, Savannah River Plant, Nov. 7 and 8, 1961.

The Fuel Core Tester, UT-2, is a nondestructive tester which measures two of the critical parameters of a fuel core: grain size and defects. The tester consists of an ultrasonic through-transmission attenuation test for grain size and an ultrasonic reflection-type test for defects. Reject separation as well as complete data recording is provided by the test. The data handling provides continuous monitoring of group quality and circuit performance. (auth)

10263 (NSF-62-35(5)) TESTING MACHINES FOR INVESTIGATING THE MECHANICAL PROPERTIES OF IRRADIATED MATERIALS. A translation of "Ispytatel'nye Mashiny dlya Izucheniya Mekhanicheskikh Svoistv Obluchennykh Materialov." A. D. Amaev and L. M. Lebedev (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 14p.

Brief descriptions and technical characteristics are given for the following pieces of equipment which may be operated remotely to test small irradiated specimens: (1) a tension-testing machine for testing at high temperatures (MM-150B type), (2) a universal testing machine (YMD-5 type), and (3) an instrument for measuring the surface hardness by a diamond pyramid or steel ball (TKC-2 type). (D.L.C.)

10264 (ORNL-3252) TECHNIQUES FOR LOW-VOLTAGE RADIOGRAPHY. R. W. McClung (Oak Ridge National Lab., Tenn.). Mar. 1, 1962. Contract W-7405-Eng-26. 39p.

Developments in technique which were performed to improve the radiographic quality for relatively thin sections of such materials as aluminum, stainless steel, and beryllium are described. Theory, radiographic control, film-processing control, film-density measurements, exposure requirements, helium vs air atmosphere, other absorbers, contrast sensitivity, resolution, equivalence factors, and applications are discussed. (M.C.G.)

10265 (ORNL-TM-103) DEVELOPMENT OF ULTRASONIC TECHNIQUES FOR THE REMOTE MEASUREMENT OF THE HRT CORE VESSEL WALL THICKNESS. R. W. McClung and K. V. Cook (Oak Ridge National Lab., Tenn.). Mar. 15, 1962. Contract W-7405-eng-26. 15p.

Design and development of a remote ultrasonic inspection technique for use in measuring wall thicknesses in the HRT core vessel are described. (J.R.D.)

10266 (SCR-456) TEMPERATURE IN LENGTH MEASUREMENT. K. G. Overbury (Sandia Corp., Albuquerque, N. Mex.). Feb. 1962. Contract [AT(29-1)-789]. 13p.

Presented at Fall Instrument-Automation Conference and Exhibit, Los Angeles, California, September 11-15, 1961.

Results of an investigation are presented concerning the accuracy of length measurements made at 73.4 and 68°F. A list of recommendations and factors affecting such measurements are included. (J.R.D.)

10267 (SRO-54) APPLICATIONS OF COMPTON BACKSCATTER RADIATION TO NONDESTRUCTIVE TESTING. Final Report. J. H. Tolan, C. T. Bradshaw, and K. E. Mears (Lockheed Georgia Co., Marietta, Ga.). Sept. 1961. Contract AT(30-1)-2429. 97p. (NR-130)

The efficacy of employment of Compton backscattered radiation for one-side only measure of thickness or density was investigated for a variety of structural materials, a wide range of radiation energies, and a few basic geometrical arrangements of components. Pulse techniques were employed to provide upper and lower energy discrimination, but the results showed that this more expensive method may be discarded in favor of integrated current measurement in some applications. Favorable results were obtained in the measure of such materials as magnesium, aluminum, copper, and steel using 280 kev γ-radiation from Hg^{203} and 84 kev γ-radiation from Tm^{170}. Sensitivity of this measurement to thickness change in copper and steel was within 0.001 inch for samples from 0.010 to 0.150 inch using Hg^{203}. A thickness change within 1% was detected in the range of 0.150 to 0.300 inch for the same materials. Tm^{170} provided radiations more responsive to thickness change in the lighter materials such as magnesium and aluminum. Of particular interest was the response to thickness change in a light material clad to a heavy material as employed in fabrication of reactor fuel elements. Resolution of defect contours or discontinuities was not evaluated as thoroughly as desired, but efforts to achieve statistically significant output signals required collimator apertures too large for sharp resolution. Such ameliorating factors as increased source activity, use of dense materials like depleted uranium in collimator fabrication, and special collimator design are expected to improve this condition. Problems of probe and collimator design are discussed for each of several applications, and proposed designs are illustrated. An analytical background for the experiments is provided. (auth)

10268 (WADD-TR-61-72(Vol.IV)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME IV. ADAPTATION OF RADIOGRAPHIC PRINCIPLES TO THE QUALITY CONTROL OF GRAPHITE. R. W. Wallouch (National Carbon Co. Advanced Materials Lab., Lawrenceburg, Tenn.). July 1961. Contract AF33(616)-6915. 45p.

Special equipment and techniques were developed for the radiographic inspection of large size graphite shapes, as well as for complex multi-thickness shapes. Because of the low atomic number of the element C, techniques are used which discriminate between the transmitted and scattered radiation. Various methods are described which were used for nondestructively testing graphite and exposure charts relating exposure time to graphite thickness for various source voltages were prepared. (auth)

10269 CONCERNING REFLECTING ELECTRON MICROSCOPY FOR THE STUDY OF MAGNETIC MICROFIELDS. G. V. Spivak, L. V. Kirenskii, R. D. Ivanov, and N. N. Sedov (Moscow State Univ. and Inst. of Physics, Siberian Branch, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1465-9(Dec. 1961). (In Russian)

Electronoptical photographs of domain structures in ferromagnetic materials are shown and contrasted with photographs taken by other methods. Substantial magnifications are obtained (about 2000 X) and such enlargements by no means represent any sort of a limit. Significant data on the distribution of local magnetic fields are obtained in both massive and thin film samples of cobalt and magnetic plumbite, $PbO(Fe_2O_3)_6$. The field distribution of the domain boundaries on the sample surface are investigated using this photographic method. It is found that the decrease of the field with distance follows, as expected, an exponential curve. Also it is determined that the boundary field falls off 2.5 times faster in plumbite than in cobalt. (TTT)

10270 RADIOGRAPHY, ITS PURPOSES AND PRACTICES. R. C. Barry (Atomics International, Canoga Park, Calif.). Metal Progr., 81: No. 3, 100-5; 130; 132; 134; 136; 138(Mar. 1962).

Metal parts of all shapes and sizes can be inspected for internal flaws through the use of radiation from x-ray sources or radioactive isotopes. The fundamentals of radiographic practice are given by a typical step-by-step test procedure, and information is presented on safety precautions. (auth)

10271 THE LINEAR ACCELERATOR, A NEW TOOL FOR RADIOGRAPHY. Metal Progr., 81: No. 3, 106-7 (Mar. 1962).

Essentially a high-powered x-ray machine, this device is used mainly for inspecting welds in heavy-walled vessels. Rated at 8 Mev, the unit can produce radiographs of steel plates 1 ft thick in less than 2 min. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

10272 (ANL-6470) SOIL TEMPERATURE AND WEATHER CONDITIONS. James E. Carson (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-Eng-38. 244p.

An investigation was made of the energy exchange at the air-soil interface. The temperature regime in the soil and the thermal response of the soil to various meteorological parameters such as sunshine, air temperature, and wind speed were studied. A series of case studies, showing the temperature response of the soil in several typical weather situations were prepared and analyzed. A set of multiple regression equations was calculated to show quantitatively the temperature change in the soil as a result of a given change in the external meteorological conditions. The diurnal and annual cycles of soil and air temperature, air-soil temperature difference, and heat flux in the soil were studied. In addition the annual cycle of daily range of soil temperature and the interdiurnal temperature variability were analyzed. Data on frost in the soil are presented. (M.C.G.)

10273 (CEA-2034) METHODES DE CHRONOLOGIE PAR LE DESEQUILIBRE RADIOACTIF. (Dating Methods Based on the Radioactive Disequilibrium). C. Coquema, R. Coulomb, M. Goldsztein, and J. C. Schiltz (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). 1961. 43p.

The existence in the uranium families of two long-life descendants, ionium (half life 80,000 years) and protactinium (half life 32,000 years) together with the differences in geochemical behavior of the various natural radioelements, particularly thorium, makes it possible to envisage several models of geological time scales covering periods to 500,000 years. The theory of two of the most important models is developed and methods are described for making radiochemical measurements on the various nuclides which are essential for resolving these models (U^{238}, Th^{234}, Th^{230}, Ra^{226}, Pa^{231}, Th^{232}, Th^{228}, Po^{210}). An example of dating is given in the case of a secondary mineralization on a weathered portion of a deposit in the Limouzat (Forez). Samples of autunite and chalcolite taken at different levels of the mine were calculated to be between 30,000 and 240,000 years old. (auth)

10274 (PNE-108P) PARTICLE MOTION NEAR A NUCLEAR DETONATION IN HALITE. PROJECT GNOME. W. D. Weart (Sandia Corp., Albuquerque, N. Mex.). Feb. 1962. Contract [AT(29-1)-789]. 62p.

Strong motion parameters from the Project Gnome operation were successfully measured in the region extending from 60 to 480 meters along both vertical and horizontal radii. Postshot cavity pressure and temperature were not obtained because of cable failure. Times of arrival taken from acceleration channels gave a velocity in the salt of 4.82 km/sec. Vertically, the velocities varied from 4.8 km/sec to 0.85 km/sec at the surface owing to varying lithology. Peak accelerations in the salt attenuated as $R^{-5.3}$ from 60 to 122 meters and as $R^{-2.7}$ from 122 to 480 meters. Peak velocities attenuated as $R^{-3.56}$ out to 100 meters and as $R^{-1.36}$ from 100 to 480 meters. Information on peak values of displacement was not obtained closer than 229 meters because of early cable failure. Stress and strain data are similarly limited. Peak values of acceleration, velocity, and displacement at surface zero were 25 g, 5.6 m/sec, and 168 cm, respectively. At a horizontal distance of 298 meters, free-field data were 26 g, 3 m/sec, and a peak displacement of 7.6 cm. Residual displacement at this station was 79 cm. (auth)

10275 (PNE-111P) INTERMEDIATE RANGE EARTH MOTION MEASUREMENTS (Stanford Research Inst., Menlo Park, Calif.). Feb. 19, 1962. Contract [AT(04-3)-115]. 57p. Project GNOME.

A total of 31 gage channels was installed for ground motion measurements on the Gnome shot (predicted yield of 5 kt) conducted at a depth of 366 meters in salt beds near Carlsbad, New Mexico. Acceleration measurements were made at the surface and at shot depth at four ranges from 800 to 9500 meters. Surface measurements of particle velocity were made at 402 and 805 meters using three-component velocity gages, and at five more distant stations (8380 to 9357 meters) using seismometers. Pressure measurements were made in the fluid and four annuli of the well known as the Shell James Ranch No. 1 well which was about 9.5 km from ground zero. In general the accelerations and peak particle velocities observed were similar to those predicted; and the usual effect of the free surface in increasing particle motions was observed in general, although not universally. Spalling of the surface formation was noted out to 805 meters. It is estimated that the observed radial particle velocity at the Shell well corresponded to a peak over-stress of about 14 psi in the formation. Effects of the explosion were insufficient to cause damage at this 9.5-km distance, and it is concluded that there were no damaging effects at greater ranges. (auth)

10276 (RME-4525(Rev.)) RECONNAISSANCE FOR URANIUM IN THE IQUIQUE AREA, PROVINCE OF TARAPACA, CHILE. William A. Bowes, Paul H. Knowles, Mario Serrano C., and Erik Klohn H. (Division of Raw Materials, AEC and Chile. Instituto de Investigaciones Geológicas, Santiago). Oct. 1958. 13p.

The Iquique area of northern Chile was investigated for uranium in 1958 by personnel of the Instituto de Investigaciones Geológicas de Chile and the U. S. Atomic Energy Commission. The bedrocks are Jurassic marine and continental sedimentary rocks and interstratified andesitic volcanics intruded by the Andean diorite complex. The rocks are cut by major north-trending faults as well as by east-trending faults, andesite dikes, and veins. The radioactivity of all rock units was low, with the highest reading associated with a cupiferous manto in limestone. Additional exploration in the Iquique area probably is not warranted. (auth)

10277 (SC-4482(RR)) MONTHLY OBSERVATIONS OF WINDS BETWEEN 100,000 AND 300,000 FEET. L. B. Smith (Sandia Corp., Albuquerque, N. Mex.). Sept. 1960. Contract [AT(29-1)-789]. 72p.

A series of wind observations at altitudes between 150,000 and 300,000 feet was taken at Tonopah Test Range, Nevada, from November 1958 to November 1959. Measurements were made by radar tracking of 5-cm chaff strips ejected from a rocket. Although ejection was regularly accomplished above 300,000 feet, the chaff was in free fall to approximately 275,000 feet. Wind data are thus limited to this level and below. Individual observations of components with corresponding fall rate and vertical shear as a function of altitude for each run are listed. Also included are mean seasonal 5,000- and 20,000-foot layer wind distributions,

and 6- and 12-hour and annual variations. A discussion is given on high-altitude circulation as evidenced by these wind data and those from grenade and meteor-trail observations. (auth)

10278 (TEI-803) GROUND WATER TEST WELL D, NEVADA TEST SITE, NYE COUNTY, NEVADA. William Thordarson, Murray S. Garber, and George E. Walker (Geological Survey, Washington, D. C.). Feb. 1962. 59p.

Ground-water test well D was drilled to a depth of 1,950 feet with rotary and cable-tool drilling rigs. It penetrated alluvium from 0 to 1,505 feet; tuff of Tertiary age from 1,505 to 1,730 feet; talus (?) breccia from 1,730 to 1,750 feet; and rocks of Mississippian to Pennsylvanian age from 1,750 to 1,950 feet. The Paleozoic bedrock in the depth interval from about 1,750 to 1,840 feet is composed mainly of interbedded dolomite and limestone; in the interval 1,840 to 1,950 feet it consists of argillite. The static water level is about 1,733 feet below the land surface (altitude, 2,417 feet). The aquifer in test well D comprises the talus (?) breccia and the carbonate rocks in the interval from 1,730 to 1,840 feet. Tests by bailing indicated that the minimum transmissibility of the aquifer is about 90 gallons per day per foot. The specific capacity was less than 0.3 gallons per minute per foot after 3¼ hours of bailing at a rate of 18 gallons per minute. These tests also indicated that the transmissibility of the argillite stratum underlying the aquifer is extremely low. A suite of geophysical logs, a summary of contract costs, and detailed descriptions of the drilling machines, drilling operations, and the casing and cementing operations are presented. (auth)

10279 (TID-14996) SOME DIRECT MEASUREMENTS OF THE NON-TIDAL DRIFT ON THE CONTINENTAL SHELF BETWEEN CAPE COD AND CAPE HATTERAS. Reference No. 62-3. Malcolm R. Howe (Woods Hole Oceanographic Institution, Mass.). Jan. 1962. Contract AT(30-1)-2662. 38p.

A series of cruises was made between Cape Cod and Cape Hatteras in an attempt to monitor any large scale changes in the circulation of the waters on the continental shelf. Some direct measurements of the drift were correlated with the density field, and an encouraging result in the form of a regression equation was derived. By means of this equation the velocity profiles for several sections across the shelf were computed, and the difference in these from summer to early winter is discussed in relation to the seasonal changes in temperature and salinity that might be expected in this area. (auth)

10280 CONCENTRATION OF Be^7 IN GROUND-LEVEL AIR AND IN ATMOSPHERIC PRECIPITATIONS. V. P. Shvedov, Z. G. Gritchenko, and L. I. Gedeonov. Atomnaya Energ., 12: 64-6(Jan. 1962). (In Russian)

The radioactive Be^7 is formed primarily at altitudes of 12 to 15 km as the result of the interaction of fast protons and neutrons from cosmic radiation with C, N and O nuclei. The concentration of this isotope was measured in the ground-level air and in atmospheric precipitations near Leningrad starting in 1960. About $5 \cdot 10^4$ m^3 of air or dry residue from 100 to 200 liters of evaporated precipitation were passed through a filter which was subsequently heated at 500° for 1 hour. A single-channel amplitude analyzer was used for measuring the γ radiation of the ashes without previously separating Be^7. The analysis can be carried in this manner only if the contribution of other γ emitters at similar energy levels is small. From February 1960 on, a photoelectron peak was noted at the 48-kev level; the half life of this γ emitter agreed with that of Be^7. The highest concentration was found in June 1960, the lowest in January 1961, agreeing well with the seasonal changes of the ozone concentration of the air. Analysis of the precipitations, carried out since November 1960, indicates that there is a constant determining the activity transport from the precipitation to the air; its value was calculated at $4.5 \cdot 10^5$. (TTT)

10281 USE OF ION-EXCHANGE RESINS FOR CONCENTRATING ARTIFICIAL RADIOACTIVE ISOTOPES CONTAMINATING THE ATMOSPHERIC PRECIPITATIONS. G. A. Sereda and V. B. Chumichev. Atomnaya Energ., 12: 66-7(Jan. 1962). (In Russian)

The evaporation method is satisfactory for concentrating natural radioactive materials in rainwater or snow having a relatively high specific activity of about 10^{-9} curie/liter but the determination of artificial radioactive contaminants with activities in the range of 10^{-11} to 10^{-12} curie/liter by this method would require excessively large amounts of material. The ion-exchange method was found to be very useful for this purpose because the low hardness of atmospheric precipitations require relatively small amounts of resin for the determination. The rain or snow specimens were collected on trays with a surface ranging from 3 to 12 m^2 covered with polyethylene. About 10 mg of Sr, Cs, and Ce salts were added to every 10 liters of water as a carrier to prevent absorption of the radioactive materials on the container walls. After filtration through cotton, the water was passed at a rate of 2.5 to 3 liters per hour through a mixed or separate anion and cation exchange beds, using primarily resins of local manufacture. The cotton used for filtration and the resins were burned and the ashes were used for the radiochemical analysis of the atmospheric contaminants. Results indicated that nearly 100% of the radioactive materials present in the water can thus be extracted and determined. (TTT)

10282 APPARATUS FOR GAMMA-RADIATION SPECTRA OF INFINITE URANIUM ORE STRATA. S. G. Troitskii, V. L. Shashkin, and K. I. Bykova. Atomnaya Energ., 12: 67-70(Jan. 1962). (In Russian)

By means of the experimental study of the γ-ray spectra of a homogeneous radiating medium, the so-called "infinite stratum," the conditions required for the quantitative determination of ores in their natural surrounding by means of γ-ray spectral analysis may be established, resulting in improvements in γ-logging and γ-ray express analysis. Such studies were carried out with infinite and semi-infinite strata having effective atomic numbers ranging from 9 to 23. The spectra were obtained by using a NaI(Tl) scintillation spectrophotometer provided with a 100-channel pulse amplitude analyzer; the β-radiation was completely filtered out by the 4-mm Al filter used. It was found that the apparatus γ-spectrum of the infinite U ore strata is represented basically by pulses the amplitudes of which correspond to energies less than 400 kev. On the basis of differences in the effectiveness of recording the various γ-ray quanta it is estimated that about 60 to 70% of the radiation of the infinite strata of U ores are in the range of soft rays. (TTT)

10283 SEPARATE DETERMINATION OF URANIUM AND THORIUM BY MEANS OF GAMMA-RAY SPECTRA OF ORES IN THE FIELD. S. G. Troitskii, V. L. Shashkin, and K. I. Bykova. Atomnaya Energ., 12: 70-2(Jan. 1962). (In Russian)

The determination of U and Th in geological locations is complicated by the scattering of the primary γ-radiation of the rocks and requires an analysis of the γ-spectra in a wide energy range. This problem was studied by measuring the spectra of infinite and semi-infinite U and Th strata

having identical effective atomic numbers. A mixture of quartz and monazite concentrate with a Th/U ratio = 14 was used for the measurements. The possibility of determining the U and Th individually is dependent on the difference of the U equivalent in the Th at the energy range used. A high count rate is needed to ensure the required precision. For measurements below 1500 kev Pu^{239} may be used as the reference source as it covers the whole hard radiation range. Best results were obtained in the ranges of 400 to 600 and 1100 to 1300 kev. The U equivalents of Th calculated energy ranges less than about 25 kev are practically independent of the dimensions of the NaI(Tl) crystal, the effective atomic number of the medium, and the thickness of the filters usually employed. (TTT)

10284 URANIFEROUS VEIN DEPOSITS IN CRYSTALLINE ROCKS, AND THE RADIOACTIVITY OF THE ROCKS CONTAINING THE DEPOSITS. Marcel Roubault and René Coppens (Centre de Recherches Radiogeologiques, Nancy). Compt. rend., 254: 393-6(Jan. 15, 1962). (In French)

It is found that rocks containing crystalline uraniferous veins have a high average radioactivity. Moving away from the point of maximum activity causes a strong decrease in the activity, followed by a gradual increase in the activity. The distance separating the uraniferous localization and the point of minimum radioactivity varies with the importance of the deposit, going from several meters for simple localizations to several kilometers for large deposits. (tr-auth)

10285 ELEMENTS OF RARE EARTHS IN ACCESSORY MINERALS OF GRANITOIDS. V. V. Lyakhovich (Inst. of Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements, Moscow). Geokhimiya, No. 1, 37-52(1962). (In Russian)

The distribution of rare earths in accessory minerals of granitoids, apatite, sphene, garnet, epidote, fluorite, zircon, orthite, monazite, and xenotime was studied. The highest contents of rare-earth elements are typical of sphenes and fluorites. The greatest Ce contents were found in sphene and epidotes; Nd, Sm, Cd, and Dy in garnets or sphenes; and Er and Yb in garnets and zircons. (auth)

10286 ON THE POSSIBLE GEOCHEMICAL BOND BETWEEN CAESIUM AND BORON. O. D. Stavrov and V. G. Khitrov (All-Union Inst. of Mineral Raw Materials, Moscow). Geokhimiya, No. 1, 53-61(1962). (In Russian)

The correlation between cesium and boron content in granites and pegmatites is considered. Geochemical balances of the Rb and Cs distribution in granitoids show that a limited isomorphism of cesium with potassium favors a formation with granitic magma mineralizers (B, F) of typical mobile complex compounds of the $CsBF_4$ type. In pegmatites connected with intrusions of strongly impoverished boron a lepidolite-pollucite mineralization may not be expected. An original method for the determination of small boron concentrations from weighed samples of rocks and minerals, not exceeding 2 to 5 mg, is given. (auth)

10287 AGE DETERMINATION OF BERYLS AND OTHER MINERALS CONTAINING INCLUSIONS WITH THE AID OF THE Rb/Sr METHOD. E. K. Gerling, Yu. A. Shukolyukov, and I. I. Matveeva (Lab. of Geology of the Precambrian, Academy of Sciences, Leningrad). Geokhimiya, No. 1, 67-72(1962). (In Russian)

Six beryl, 2 tourmalin, and one quartz sample of ages from 350×10^6 to 2400×10^6 years were studied. Microinclusions containing a gaseous and a liquid phase were detected in all samples. The K, Rb, and Sr contents were determined by isotopic dilution. The age of micas from the same formations was found by the K/Ar-method. (auth)

10288 ANALYSIS OF THE ERRORS IN THE METHOD OF ABSOLUTE AGE DETERMINATION. I. V. Chernyshev (All-Union Scientific Research Inst. of Mineral Raw Material, Moscow). Geokhimiya, No. 1, 73-81(1962). (In Russian)

Absolute age determination by lead-isotope ratios was analyzed using the value of the mean square error and assuming the distribution of analytical errors obey a normal law. It is shown that of the contributing errors, calculating the radiogenic addition of lead isotopes is subjected to the greatest variations. (auth)

10289 A SURVEY OF FORMOSAN THORITE AND ITS COEXISTING MINERALS. Ching-Tai Shen. Ho Tsu K'o Hsueh, 1: No. 1, 9-13(1955). (In Chinese)

Thorite is found in the river beds west of the island coexisting with zircon and other minerals as magnetite, hematite, basaltic hornblend, epidote, garnet, hypersthene, staurolite, tourmaline, rutile, etc. The geological origin is not clear. The heavy sand is magnetically concentrated for thorite, hematite, magnetite, and zircon. Chemical analyses of the concentrates are done by four local institutes and the Associated Metals and Minerals Corporation, U.S.A. Total rare earths (including ThO_2) come to 63.26%, the ThO_2 from all samples average 4.21 to 6.79%. The zircon contains 65.45% of ZrO_2, HfO_2 and the ratio $HfO_2/ZrO_2 = 0.016$. The estimated total thorite deposit in Formosa is 7,500,000 metric tons of heavy sand containing 4.4% of ThO_2. (TTT)

10290 AN ESTIMATION OF THE RADIOACTIVITY OF RAIN WATER, RIVER WATER AND CITY WATER IN TAIPEI. Tung-Ju Wei and Shang-Chiu Chen. Ho Tsu K'o Hsueh, 2: No. 2, 41-3(1958). (In Chinese)

Rain water, collected directly, river water, collected from middle of the stream of Hsin Dien Chi and tap-water from the laboratory were tested for radioactivity between August 23, 1957 and December 3, 1957. The samples were evaporated and the residue dried by infrared. Beta radiation of the residues was measured. The highest count for tap water was 2.53×10^{-7} μc/ml, river water showed even less activity. The activity of rain water ranged from 1.20×10^{-7} μc/ml to 5.967×10^{-7} μc/ml, making it dangerous for direct use as drinking water. Further investigation is needed to estimate the quantity of Sr^{90} in the rain water. (TTT)

10291 THE AVERAGE LIFE OF RADIOACTIVE RAIN WATER IN TAIPEI. Ho Tsu K'o Hsueh, 2: No. 3, 33-5 (1958). (In Chinese)

Rain water samples collected during the period between August 23, 1957 and April 17, 1958 were separately tested for radioactivity and the rate of decay. The procedure used was the same as reported earlier (Nuclear Science 2: 41 (1957)). The residues contained in flat steel dishes were kept in desiccators and retested for radioactivity from time to time. A decay curve was constructed. The most radioactive samples had a half-life of ten days. The average half-life of all samples was fifty days. (TTT)

10292 ISOTOPIC COMPOSITION OF AUSTRALIAN LEADS. 2. EXPERIMENTAL PROCEDURES AND INTERLABORATORY COMPARISONS. J. R. Richards (Australian National Univ., Canberra). J. Geophys. Research, 67: 869-84(Feb. 1962).

Instrumental techniques developed for the isotopic analysis of lead minerals by gas-source mass spectrometry of tetramethyl lead are described. Close attention is given to the conditions required for the achievement of precision

and accuracy of measurement, and some interlaboratory comparisons are shown suggesting that this is achieved. Preliminary conclusions of geological interest are drawn from results of measurements on Australian leads. (auth)

10293 CONCENTRATION OF THORIUM ISOTOPES IN SEA WATER. K. F. Lazarev, D. S. Nikolaev, and S. M. Grashchenko. Radiokhimiya, 3: 623-35(1961). (In Russian)

A method was developed for concentrating thorium in large volumes of natural water (200 to 500 l) using iron hydroxide precipitation at low temperature. The contents of thorium and ionium in the Black Sea are $(2.2 \pm 0.2) \times 10^{-9}$ and $(2.5 \pm 1.0) \times 10^{-13}$ g/l, respectively. The content of thorium decreases from the coastal area to the open sea. Moreover, the thorium content decreases much faster than the ionium because larger quanities of Th^{232} are found in coarse terrigeneous suspension, while ionium occurs in fine colloidal suspensions that do not settle as easily to the bottom and are carried farther into the open basin. (R.V.J.)

HEALTH AND SAFETY

Refer also to abstracts 9771 and 11309

10294 (AHSB(S)R-18) SOME SAFETY CONSIDERATIONS IN RELATION TO GLOVE BOX DESIGN. V. Griffiths (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch, Risley, Lancs, England). 1962. 36p.

Procedures are reviewed for reducing the risk of fire, explosions, and other occurrences leading to rupture of glove box containment. Comments are included on methods of extinguishing fires and on other aspects of glove box safety. (C.H.)

10295 (APAE-109) HAZARDS REPORT FOR STEP TRANSIENT LOADING TESTS ON THE SM-1 — TASK XII. D. L. Pomeroy (Alco Products, Inc., Schenectady, N. Y.). Feb. 1, 1962. Contract AT(30-1)-2639. 21p.

Hazards involved with SM-1 plant response and system performance tests to determine the response of the SM-1 plant to step electrical and steam load changes are evaluated. The changes in plant equipment and operating procedures for this task are described. These changes are evaluated for possible additional hazards. (auth)

10296 (AWRE-O-50/61) A COMPARISON OF AIR CONDITIONS IN MANNED PRESSURISED SUITS WHEN VARYING DEGREES OF WORK ARE UNDERTAKEN. A. B. Davies (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Jan. 1962. 34p.

An account is given of the physical and analytical techniques employed in comparing the air conditions in manned pressurized suits when varying degrees of work were undertaken at different air flow rates. Comfort, carbon dioxide increase, oxygen deficiency, humidity, temperature rise between inlet and outlet air, and pressure effects were investigated. The results obtained show that the most favorable conditions were encountered in the rubber suit at an air flow rate of 5 ft^3/min. (auth)

10297 (CEX-59-7C) METHODS AND TECHNIQUES OF FALLOUT STUDIES USING A PARTICULATE SIMULANT. William Lee and Henry M. Borella (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Aug. 1960. 22p.

The fallout hazard and protection factors in current use for large groups of buildings, i.e., urban residential areas, business districts, industrial complexes, government centers, Atomic Energy Commission facilities, and academic and medical institutions, are largely unsubstantiated by experimental evidence. These data are important for personnel protection on a national basis in the event of war and on a local basis in the event of certain types of nuclear accidents. The need for such information is discussed and methods for obtaining it are suggested. The methods suggested should provide a cross check of the data obtained on isolated structures under actual fallout conditions with the data from studies that made use of methods such as distributed point sources and a moving single-point source (as used in the Mobile Radiological Measurement Unit, Civil Effects Test Operations) to simulate actual fallout fields and with data from other studies in which predicted values of fallout protection were calculated from strictly theoretical considerations. (auth)

10298 (CEX-60.5) EXPERIMENTAL EVALUATION OF THE FALLOUT RADIATION PROTECTION AFFORDED BY A TYPICAL SOUTHWESTERN RESIDENTIAL HOME. Z. Burson, D. Parry, and H. Borella (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Mar. 14, 1961. 33p. (S-32)

An experimental study was conducted to determine the fallout-radiation protection afforded by a residence representative of a type of construction much in favor in the Southwest: a single-story stucco and frame house with a heavy shake roof and no basement. The protection afforded by the home was determined by simulating a fallout-radiation field above and immediately surrounding the house and measuring the radiation level within. The radiation field was simulated by pumping a sealed Co^{60} source through a long length of tubing evenly distributed over the test area. Highly sensitive dose-integrating ionization chambers were used to measure the radiation level inside the structure. The test was performed rapidly, easily, and safely. Valid statistical data were obtained even though the radiation level was of such low magnitude that it was unnecessary to evacuate any of the neighboring homes. The protection factors within the house (ratio of exposure dose rate in the open field to exposure dose rate in the structure) ranged from 2.8 to 4.4, depending on the location. The results compare favorably with those found in previous exercises under similar conditions. (auth)

10299 (DC-55-5-87) GAMMA ACTIVITY OF AIR. T. J. Kostigen (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 17, 1955. Contract AT(11-1)-171. 8p.

An estimate of the gamma activity of air when exposed to thermal neutron radiation is plotted. (auth)

10300 (DC 59-10-745) EXPECTED DOSAGES IN THE IET AREA AS A RESULT OF A NUCLEAR ACCIDENT. L. D. VanVleck (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 27, 1959. Contract AT(11-1)-171. 15p.

Estimates are given for the dose an individual would receive if he was located outside of the control and equipment building within the IET exclusion fence at the time of the occurrance of the one-tube burnout accident. For HTRE-2 operations, prohibiting personnel from passing within 25 feet of the duct work, test cell, or electrostatic precipitator is adequate to guarantee that doses as high as 25 rem will not occur. If traffic is restrained from passing within 75 feet of the duct work test cell, or electrostatic precipitator, the exposure can be limited to less than the yearly allowable exposure. The HTRE 3 (Phase II) analysis indicates that the direct radiation is so high and working time limits so short that workmen should not be allowed outside of the control and equipment building. (auth)

10301 (HW-71743) PROBABLE VOLATILIZATION OF PLUTONIUM DURING A FIRE. R. K. Hilliard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1, 1961. Contract AT(45-1)-1350. 18p.

Fire hazards involving plutonium are discussed. The available experimental information was evaluated and compared with theoretical volatilization rates in order to make an estimate of the amount of plutonium released to the atmosphere in a fire. It was determined that the probable maximum release of plutonium is 0.08%. The most likely mechanism for releasing plutonium to the atmosphere appeared to be the dispersal of small plutonium oxide particles by air currents. (M.C.G.)

10302 (IDO-19302) IDO REPORT ON THE NUCLEAR INCIDENT AT THE SL-1 REACTOR, JANUARY 3, 1961 AT THE NATIONAL REACTOR TESTING STATION. (Idaho Operations Office, AEC). 197p.

A summary of activities which took place following an incident at the SL-1 is presented. No attempt to determine the incident cause is included. A brief description of the SL-1 and the operating program in progress prior to the incident is given along with detailed information on various aspects of the past incident developments. (J.R.D.)

10303 (NAA-SR-5700) FINAL SUMMARY SAFEGUARDS REPORT FOR THE HALLAM NUCLEAR POWER FACILITY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1961. Contract AT(11-1)-GEN-8. 428p.

A description of the Hallam Nuclear Power Facility is presented. The potential hazards and controlling safeguards are discussed. The reactor system, sodium heat transfer system, instrumentation and control, auxiliary systems, fuel and component handling facilities, reactor plant building and facilities, radioactive waste facility, and site are described. Normal conditions, abnormal conditions, operations, and accident evaluations are discussed. (M.C.G.)

10304 (NAA-SR-5700(Suppl.1)) SAFEGUARDS REPORT ON DRY, ZERO-POWER EXPERIMENTS IN HNPF. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 22, 1961. Contract AT-11-1-GEN-8. 31p.

A description is given of the dry, zero-power experiments, including the status of relevant systems and plant components, and special precautions taken in addition to normal operating procedures. The principle potential hazard associated with these tests is the inadvertent addition of a large amount of excess reactivity to the core through improper fuel loading and/or malfunction of the control rods. These situations were analyzed and the safeguards against any hazards are presented. The test procedure is outlined. (M.C.G.)

10305 (NAA-SR-5700(Suppl.2)) ADDITIONAL INFORMATION ON DRY, ZERO-POWER EXPERIMENTS IN HNPF. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 1961. Contract AT(11-1)-GEN-8. 86p.

A report is presented which contains answers to questions on HNPF dry, zero power experiments as posed in letter to Atomics International (4275AT) from Division of Licensing and Regulations of the Atomic Energy Commission, Aug. 1961. The questions concern protective system interlocks, stack monitor, storage cell criticality, evacuation procedures, number of licensed operators available for control room duty, personnel resumes, and preoperational test criteria. (J.R.D.)

10306 (NAA-SR-5700(Suppl.3)) ADDITIONAL SAFEGUARDS INFORMATION FOR HALLAM NUCLEAR POWER FACILITY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 1961. Contract AT-11-1-GEN-8. 138p.

Questions concerning the plant control and protective systems, primary system components, maintenance and inspection procedures, effluent control, and training as part of the hazards analysis are answered. (M.C.G.)

10307 (NAA-SR-5700(Suppl.4)) ADDITIONAL SAFEGUARDS INFORMATION FOR HALLAM NUCLEAR POWER FACILITY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1961. Contract AT-11-1-GEN-8. 262p.

Questions in the hazards analysis concerning core kinetics and reactivity accidents, primary system confinement cavities, effluent control, fire and/or explosion, casualty conditions, and plant testing and operation are answered. (M.C.G.)

10308 (NP-11303) SHELTER HABITABILITY STUDIES: THE EFFECT OF OXYGEN DEPLETION AND FIRE GASES ON OCCUPANTS OF SHELTERS. J. S. Muraoka (Naval Civil Engineering Lab., Port Hueneme, Calif.). July 18, 1961. 33p.

Results are presented from literature study on the effects of various gases on shelter occupancy. Various physiological effects from simple headache to unconsciousness and death are experienced by personnel in closed occupied rooms by breathing air containing excess carbon dioxide and carbon monoxide, or inadequate oxygen. During fire catastrophes, casualties result from flames, heat, and falling objects, but a greater number of casualties are caused by fire gases, especially carbon monoxide, which infiltrate open shelters. Shelters exposed to the hazard of mass fire should have all their openings closed to prevent the entrance of fire gases, and should employ chemical oxygen generators and carbon dioxide absorbents for air revitalization. These chemicals will produce better breathing conditions inside closed shelters. However, since they also produce heat during chemical reaction, their use must be limited. 37 references. (auth)

10309 (UCLA-500) BIOLOGICAL AVAILABILITY OF Sr^{90} TO SMALL NATIVE ANIMALS IN FALLOUT PATTERNS FROM THE NEVADA TEST SITE. J. W. Neel and K. H. Larson (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Dec. 1961. Contract AT(04-1)-Gen-12. 18p.

The levels of Sr^{90} soil contamination originating from Nevada Test Site activities and the Sr^{90} bone levels of native jack rabbits and, in some cases, kangaroo rats, were determined in areas at different distances from the test site. Detailed studies showed Sr^{90} to be persistent in the surface soil over a period of one year, and other observations indicated persistence for at least several years. Jack rabbits collected in 1958, one year after contamination by the fallout from the Plumbbob Series in an area 99 miles from ground zero had Sr^{90} levels averaging 19.4 Sr units at all ages. A similar collection in 1961 revealed a much reduced level of Sr^{90} in the population (10.0 Sr units average) with the few higher values restricted to the older animals. It is postulated that the biological availability of Sr^{90} in fall-out is at its maximum at an early time after contamination; at later time the biological availability tends to be reduced by natural mechanisms in the environment. (auth)

10310 (AEC-tr-4964) NEW TYPES OF STANDARD SHELTERS. Goesta Smitt. Translated from Väg- och Vattenbyggaren, No. 1, 9-12(Feb. 5, 1961). 11p.

General principles of the regulations concerning shelter design, construction, equipment, etc. are discussed. (M.C.G.)

10311 (AWRE-Trans-29) THE LAUNDERING OF MATERIALS LABELLED BY MEANS OF RADIOACTIVE ISOTOPES. I. Halász. Translated by S. L. Somerville (U.K.A.E.A. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) from Magyar Textiltech., 2: No. 6, 239-41(1959). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 24403.

10312 (JPRS-12166) ON THE PROBLEM OF THE NECESSITY OF DETERMINING THE RADIOACTIVITY OF WATER WHEN SELECTING UNDERGROUND SOURCES OF

DRINKABLE-WATER SUPPLY. I. E. (Ye.) Mukhin. Translated from Gigiena i Sanit., 26: No. 11, 9-23(Nov. 1961). 8p.

A study was made of the content of radioisotopes in the water of wells. Approximately 30 sources of drinkable-water supply were encompassed by the studies. It was assumed that the detected radioactivity of water completely depends on the geological structure of the region. Water of the examined sources contained radioactive materials in quantities exceeding the maximum permissible concentration. (M.C.G.)

10313 THE CALCULATION OF γ DOSES RECEIVED BY MOVING BODIES. George Ionescu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 279-85 (1961). (In Rumanian)

A method is proposed for calculating the doses received by bodies in motion. This method can be applied, in practice, to the case where the bodies pass to the side of a radioactive source or to the case where the bodies cross a radioactive zone, as is the case of two cosmic zones surrounding the earth. The manner in which this method of calculation should be applied to the case of the passage of a human to the side of a radioactive source is explained. (tr-auth)

10314 RADIOACTIVITY OF PRECIPITATIONS AND ATMOSPHERIC DEPOSITS AT CLUJ DURING THE PERIOD FROM APRIL 1–DECEMBER 31, 1960. M. Bologa and G. Văsaru (Inst. of Atomic Physics, Cluj, Rumania). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 609-12(1961). (In Rumania)

The results of measurements of the radioactivity of precipitations and atmospheric deposits in the village of Cluj during the period from April 1 to December 31, 1960, are presented. (tr-auth)

10315 IMPROVEMENTS IN THE PHOTOGRAPHIC PERSONNEL RADIATION MONITORING METHOD. L. S. Druskina, T. G. Dmitrieva, and Yu. A. Filippov. Atomnaya Energ., 12: 57-8(Jan. 1962). (In Russian)

The widely used photographic method of personnel monitoring presents the disadvantage of a narrow latitude both at high and low integrated doses. This shortcoming was remedied by using a photographic intensifying or reducing technique; the usual sensitizing methods could not be used because they are either dependent on the hardness and the intensity of the radiation or lower the upper limit of sensitivity of the film. The "Roentgen XX" type negative the sensitivity of which corresponds to a 3-day dose of the highest permissible exposure was successfully used at various levels. After development with the usual metol-hydroquinone developler, the film was reduced by treating it with a K ferrocyanide-Na thiosulfate reducer, determining its optical density after processing. For very low doses a quinone-thiosulfate intensifier was used. Both agents have a proportional action at various levels of darkening of the negative. The actual processing conditions must be determined individually for each type of film and must be carefully controlled. (TTT)

10316 THE HANDLING OF RADIOACTIVE MATERIALS. H. F. J. Hadrill (Central Electricity Generating Board, London). Brit. Power Eng., 2: No. 4, 53-5(Mar. 1961).

The fundamentals and the dangers inherent in handling radioactive materials are discussed, making particular reference to reactor coolants (gas, water, and liquid metals). The danger inherent in handling radioactive materials lies in the electromagnetic radiation produced when atomic particles collide or interact with various substances. Precautions and methods of protection from radioactive materials are given. (N.W.R.)

10317 RADIATION SURVEY METER. R. W. Lehnert and J. M. McKenzie (Amperex Electronic Corp., Hicksville, N. Y.). Electronics, 35: No. 8, 50(Feb. 1961).

A small radiation survey meter is described which has two modes of operation, pulsed and current, and which is used for detecting the contamination from a nuclear explosion. Since the response curve slope in both pulsed and current modes are the same, only one meter scale is necessary. The circuit design and operation are described for a survey meter which has a pulsed range of 0.5 to 50 mr/hr and a current range of 0.050 to 5 r/hr. (N.W.R.)

10318 PERMISSIBLE CONCENTRATIONS OF RADIONUCLIDES IN SEA WATER. A. H. W. Aten, Jr. (Inst. for Nuclear Physics Research, Amsterdam). Health Phys., 6: 114-25(Oct. 1961).

Methods are discussed for the calculation of the maximum permissible concentration of various radionuclides in sea water. The values are based on the maximum permissible concentrations in drinking water as fixed by the I.C.R.P. Concentration factors of radionuclides in fish are discussed and the protection of fish against the uptake of radioactive nuclides by inactive isotopes and by elements in the sea water which are chemically related to the radioisotopes is taken into account. In the Appendix the application of the maximum permissible concentrations in sea water is discussed for simplified case of waste disposal into the sea. (auth)

10319 RADIATION EFFECTS OF A 10-MW REACTOR ON ENVIRONS OF THE GEORGIA NUCLEAR LABORATORIES. J. M. Selby, C. A. Willis, B. M. Bowen, and J. H. Edgerton (Lockheed Aircraft Corp., Marietta, Ga.). Health Phys., 6: 126-35(Oct. 1961).

The Radiation Effects Reactor (RER) has been operated for approximately 600 Mwh. During that time, studies were made to determine the radiation and activation effects on the environs of the Georgia Nuclear Laboratories (AFP 67). Soil, air, and water samples were collected to determine the amount of activation and the resulting buildup of radioactive materials. Instrument surveys and foil measurements were made to determine radiation levels. The effects of high γ- and neutron exposures on plant life were observed as part of an ecology program performed in conjunction with Emory University. A preliminary report of these studies is given. (auth)

10320 EVALUATION OF THE VENTILATION RATE FROM THE DECAY OF FILTER-PAPER AIR SAMPLES OF THORON OR RADON DAUGHTERS. K. S. Somayaji (Atomic Energy Establishment, Trombay, India). Health Phys., 6: 136-41(Oct. 1961).

A simple method of obtaining the ventilation rate in a thoron field and the relative non-equilibrium among the decay products of thoron is described. It is indicated how the ratio of the α activity after a delay of 150 min to that after a delay of 30 min can be used as a convenient parameter to do this. Curves are given showing the variation of the potential α energy values for thoron and radon daughters with the ventilation rate, which are useful when planning control by means of ventilation. (auth)

10321 MEASUREMENT OF CAESIUM-137 IN MILK. K. G. Vohra, V. S. Bhatnagar, U. C. Mishra, and S. Ragupathy (Atomic Energy Establishment, Trombay, India). Health Phys., 6: 142-8(Oct. 1961).

Samples of liquid milk from Bombay and twenty-seven

other stations in India, and imported powder milk from Australia, Denmark, Holland, U.K., and the United States were measured for their cesium-137 and potassium-40 contents. The average cesium-137 content of Bombay milk was 9.38 μμc per g potassium for the year 1958, 18.26 μμc per g of potassium for 1959, and 14.71 μμc/g potassium for the first 2 months of 1960. The increase in the average level of cesium-137 by a factor of 2 during 1959 was attributed to the accelerated fall-out rate following the large number of tests conducted during the autumn of 1958. The cesium-137 content in the Australian powder milk was found to be about the same and in the European powder milk about two or three times that in the Indian powder milk. There are large variations in the levels of cesium-137 in different samples from India including Gangtok (Sikkim State). The values range from 2.79 to 159.9 μμc per g of potassium, the highest value being for Gangtok. (auth)

10322 STATISTICAL TREATMENT OF ENVIRONMENTAL RADIO-ASSAY DATA. Gerald W. Kerr (Pratt & Whitney Aircraft, Middletown, Conn.). Health Phys., 6: 152-62(Oct. 1961).

A program for environmental monitoring, which is applied to the CANEL site located at Middletown, Connecticut, is outlined. Information on sample locations, sampling methods and procedures, treatment and analysis of data, and interpretation of data is given. Samples of water, soil, silt, vegetation, drinking water, air, precipitation, and fallout are collected and analyzed. The program is offered as a new approach to environmental monitoring with respect to selection of sample locations, determination of sampling frequency, and analysis of data. (auth)

10323 HEALTH PHYSICS PROBLEMS OF THE U. S. ARMY IONIZING RADIATION CENTER. J. L. Donovan (Univ. of Michigan, Ann Arbor). Health Phys., 6: 198-202 (Oct. 1961).

Some of the more unusual health physics problems associated with two very large sources of ionizing radiation are presented together with the proposed solutions. Successful solution of these problems is a vital part in the development of food processing techniques that are both safe and economical. (auth)

10324 EQUIPMENT FOR SELF-MONITORING IN A PLUTONIUM FACILITY. R. D. Smith and V. P. Johnson (Dow Chemical Co., Denver). Health Phys., 6: 218-19(Oct. 1961).

Descriptions are given of three instruments developed in an effort to provide adequate self-monitoring at Rocky Flats. Each is suited for a distinct application. The instruments are: a modification of the Eberline Instrument Corporation's PAC-1A for dry-box workers; a battery-powered console-type instrument for monitoring hands, clothing, and shoes; and a modification of the NRD Instrument Company's CRM-560 Count Rate Meter for hands. In routine usage, all three of the instruments are capable of showing the absence or presence of gross contamination. Spots of α contamination as low as 400 counts/min (at 2π geometry) are commonly detected. (P.C.H.)

10325 MAINTENANCE AND FIELD PERFORMANCE OF THE PAC-G α-SURVEY METER UNDER EXTREME ENVIRONMENTAL CONDITIONS. H. C. Woods (RCA Service Co., Riverton, N. J.) and F. M. Crandall. Health Phys., 6: 223-4(Oct. 1961).

Problems in α monitoring at the Nevada Test Site are caused by altitudes varying from approximately 3000 to 7500 ft above sea level and relative humidity and temperature changes. These changes cause shifts in the α and β sensitivity of monitoring equipment. Additional problems are presented by static electricity accumulation due to low relative humidities, by airborne sand and dust, and by seasonal variations in temperature from 0 to 115°F. However, by departing from common practice and adjusting high-voltage supplies to 1550 v, the instruments are made useful over the entire range of altitudes. Although this adjustment places the operating point very near the knee of the curve, high-voltage supplies in the instruments have proved suffficiently stable to prevent a voltage shift large enough to affect the operation. The effects of both wind and humidity are minimized by positive gas pressure within the probe. (P.C.H.)

10326 STEAM-DETERGENT DECONTAMINATION GUN. J. Neil. Health Phys., 6: 226-7(Oct. 1961).

The advantages, function, and description of the decontamination gun are discussed. It was found that the shape of the nozzle through which the mixture was ejected greatly influenced the measure of success of the technique. A flat nozzle with a very thin orifice was found to be most effective. The unit is designed to function in the following manner: a high-pressure (at about 90 lb/in.^{2}, gauge) serves to pressurize a tank filled with detergent solution; the detergent solution is fed slowly into the main steam stream by menas of a mixing valve. The detergent flow is approximately 4 gal/hr. Three types of guns are illustrated. (P.C.H.)

10327 FALLOUT STUDIES ON THE TSING-HUA CAMPUS. Lien-Shung Chuang (National Tsing-Hua Univ., Taipei, [China]). Ho Tsu K'o Hsueh, 3: No. 2, 41-9(1961). (In Chinese).

Various methods of collecting fallout samples were studied. It was found that use of a dust collector containing water resulted in a higher efficiency of collection than the use of gummed-paper as a collector. The average radioactive contamination of rain-water and of air samples during the time of measurements was found to be below the maximum permissible concentration suggested by the International Commission on Radiation Protection. It was also found that rains brought down radioactive material in amounts of the order of several tens of times that which settled in fine weather. Despite the present suspension of nuclear detonation tests a comparatively high radioactive contamination of rain water and of air occurred intermittently. It is postulated that this effect is due to the radioactive dust in the stratosphere produced prior to the suspension of nuclear tests in October, 1958. The $t^{-1.2}$ decay is applied to estimate the approximate date of the nuclear detonation. A sample collected on February 20, 1960 indicated that it came from the first French atomic bomb test. (TTT)

10328 CALCULATIONS OF γ EMITTER ACTIVITY FOR RADIOISOTOPIC APPARATUS. M. L. Berman and V. I. Florentsev. Izmeritel'naya Tekh., No. 1, 53-4(Jan. 1962). (In Russian)

The relationship between source activity and measurement precision, considering γ scattering in the medium, is analyzed. (R.V.J.)

10329 AN EXPRESS METHOD OF INTRAVITAL DETERMINATION OF Sr^{90} IN THE ORGANISM OF MAN AND ANIMALS. I. B. Keirim-Markus, A. N. Marei, L. N. Uspenskii, A. S. Yakovlev, and E. I. Yartsev. Med. Radiol., 6: No. 12, 51-5(Dec. 1961). (In Russian)

A scintillation detector is used for measuring Sr-90 beta emission from the teeth. The equipment and procedures are detailed. (R.V.J.)

10330 MEASUREMENTS OF CAESIUM-137 IN HUMAN BEINGS DURING 1958-61. G. Maycock, Sheila W. McCansh, and J. Vennart (Radiological Protection Service, Belmont, Surrey, Eng.). Nature, 193: 516-17(Feb. 10, 1962).

Cesium-137 measurements made in 1958 to 1961 are reported for people who had worked in the radium luminizing industry, the staff of the Radiological Protection Service, and patients from mental hospitals. Most of the people monitored lived in or around London. The results show that the mean annual dose due to cesium-137 in the body was less than 2 mrem/year and that the mean cesium-137 content in the body remained fairly constant in 1958 to 1961 and then began to decrease in the early part of 1961. It is noted that slightly higher cesium-137 contents were observed for young people over older people and for males over females of similar average age. (D.L.C.)

10331 RADIOACTIVITY IN MAN, BEAST AND FOOD. A. T. Krebs (U. S. Army Medical Research Lab., Fort Knox, Ky.). Nature, 193: 622-4(Feb. 17, 1962).

The complexity of the radioactivity of living beings, especially man, is illustrated by the results obtained in recent work on the radium content of soft human tissues; total alpha activity of men, other animals, and foodstuffs; and radium-poisoning and -treatment victims still living from the early 'twenties and 'thirties. The results cast doubts for the first time on the distribution of naturally incorporated radium in the body, maintaining that only about one-fourth of the total radium content of the body is deposited in the skeleton and approximately three-quarters in the soft tissues of man. Heretofore, 75% was believed to be cumulated in the skeleton and 25% in the soft tissues. The new findings confirm the fact that in addition to radium-226 other alpha-emitting elements play a significant part in the total radioactivity of man, animal, and food, leading to much higher radiation doses and higher daily-intake activities than previously assumed. The results also show that individuals who have incorporated radium and thorium into their bodies in the early 'twenties and 'thirties are still alive carrying up to 40 microcuries of radium in the body. (N.W.R.)

10332 OCCURRENCE OF BISMUTH-207 AT ENIWETOK ATOLL. F. G. Lowman and R. F. Palumbo (Univ. of Washington, Seattle). Nature, 193: 796-7(Feb. 24, 1962).

Alga samples collected at Eniwetok Atoll in March 1961 were subjected to numerous spectral, chemical, and chromatographic tests for Bi^{207}. All tests were positive. (D.L.C.)

10333 THE MIGRATION OF Sr^{90} IN SOILS. Adolf Kloke (Biologische Bundesanstalt für Land- und Forstwirtschaft, Berlin). Naturwissenschaften, 48: 674(1961). (In German)

In order to determine the extent of the leaching of Sr^{90} in soils, samples of both farm and pasture land were taken at depths of 5 to 15 cm, 25 to 35 cm, and 45 to 55 cm and the strontium concentration was determined. The results are tabulated and show that in the 5 to 15 cm layer the Sr^{90} in the farm land is higher by a factor of 2.5 than in the meadow land. In all the samples studied, no Sr^{90} was found in the 45 to 55 cm layer. The Sr^{90} concentration in the 5 to 15 cm layer of farm land was higher by a factor of 8.0 than in the 25 to 35 cm layer. The factor was 9.0 for meadow lands. From these results it is shown that the vertical migration of Sr^{90} is very low and the contamination of ground water should not be feared. (J.S.R.)

10334 STUDIES IN RADIOACTIVE FALLOUT IN NEW ZEALAND. PART 1. THE MEASUREMENT OF RADIOCAESIUM, -STRONTIUM, -BARIUM, AND -CERIUM IN RAINWATER. G. S. McNaughton and R. N. Woodward (Dept. of Scientific and Industrial Research, Lower Hutt, N. Z.). New Zealand J. Sci., 4: 523-33(Sept. 1961). (In English)

An analysis scheme which has been used during the past year to determine Cs^{137}, Ce^{144}, Sr^{90}, and Ba^{140} in every rain at Lower Hutt, New Zealand, is presented. Rainwater is collected in a polythene tank containing carriers, and soluble cationic material is absorbed by a Dowex-50 resin column. The above isotopes are separated by elution with 0.7 m HCl, 1.5 m ammonium lactate and 4 m HCl. The cesium and cerium fractions are radiochemically purified before counting, the former with a gamma spectrometer and the latter with a low-background beta counter. The Sr^{90} and Ba^{140} are reabsorbed on ion exchange columns and their Yt^{90} and La^{140} daughters are eluted with pH 3.8 ammonium citrate, precipitated with yttrium oxalate and counted in a low background counter. The recovery of each carrier is determined chemically. Inherent errors in the method due to counting statistics and decay of activity are equivalent to deposited activities of about 5, 0.2, 0.4, and 0.8 micro curies/sq mile for Cs^{137}, Ce^{144}, Sr^{90}, and Ba^{140} respectively, at the 90% confidence level. (auth)

10335 HAND MONITOR FOR SIMULTANEOUS MEASUREMENT OF α AND β CONTAMINATION. I. O. Anderson, J. Braun, and B. Soederlund (Aktiebolaget Atomenergi, Stockholm). Nukleonik, 3: 247-50(Nov. 1961). (In English)

An instrument is described which measures α and β contamination of the hands simultaneously. This has been achieved by using as detectors 8 flow counters paired in 4 units of two chambers, one unit for each side of the hand. The inner chamber of every unit (adjacent to the hands) delivers α pulses, the outer chambers deliver β pulses. When two finger contacts are pushed, the detectors are closing around the hands and the measurement is started. Audible and visual warnings operate when the MPL is exceeded. Similar warnings operate if hands are removed before the end of the counting period. The activity levels are logarithmically indicated on four pointer instruments, which are automatically zeroed when the next measurement is started. The instrument is now commercially available. (auth)

10336 LIMITS OF PRECISION IN PHOTOGRAPHIC DOSIMETRY. G. Scarpa (Università, Rome). Nuntius Radiol., 27: 573-99(July 1961). (In Italian)

Experiments were carried out in order to establish the cause and the number of the errors which may be made in photographic dosimetry, as well as to study the practical methods for reducing them as much as possible. It is concluded that such errors, which are remarkable in the "film monitoring" sector, are of relatively little importance in the sector of the studies on the dose distribution on a mannequin, with figures (±5 to 7%) which deviate little from those obtainable by the normal ionimetric method. These results are valid, provided that some rules of technique are followed, especially concerning the method for recording the characteristic curve and the modalities in development of the film. (auth)

10337 SOME NON-CONFORMIST OBSERVATIONS ON THE DOSIMETRY OF IONIZING RADIATIONS. H. R. Schinz and R. Wideroe (Kantonsspital, Zurich). Nuntius Radiol., 27: 637-58(Aug. 1961). (In Italian)

The authors seek by the utilization of precise and rational terms to suppress all the "problematics" posed by measurements in the radiological domain. The measurement of

the radiation intensity (in particular outside the body) is called radiometry and should be clearly differentiated from measurements made inside the body (dosimetry). In radiometry the unit of radiation density is the roentgen, and this unit and the methods used to determine it (electron equilibrium) should be used only in radiometry. The unit of dosimetry is the rad and the auxiliary unit for ionization determinations is the rho. All the dosimetric measurements should be made by the Bragg-Gray principle with thin-walled microchambers. The systematic application of these concepts in connection with the utilization of terms as precise and clear as possible (self-control is necessary) makes the problems and confusion existing at the present to largely disappear. (tr-auth)

10338 A PRACTICAL SCINTILLATION DOSE DETECTOR FOR X-RAY THERAPY. G. Lanzi and G. F. Mazzoleni (Università, Pavia, Italy). Radiobiol. radioterap. e fis. med., (3) 16: 296-312(1961). (In Italian)

In addition to a critical review of dosimetric methods, a practical scintillation dose detector is proposed for x rays. Its characteristics, particularly in connection with routine x-ray therapy, are discussed. (auth)

10339 SUPPLEMENT TO THE REPORT OF THE FAO EXPERT COMMITTEE ON RADIOACTIVE MATERIALS IN FOOD AND AGRICULTURE, ROME, 30 NOVEMBER–11 DECEMBER 1959. Working Papers Submitted to the Committee. (Food and Agriculture Organization of the United Nations, Rome). 1960. 321p. (A/AC.82/G/L-288(Suppl.)).

The Expert Committee on Radioactive Materials in Food and Agriculture of the Food and Agriculture Organization of the United Nations was convened in Rome from Nov. 30 to Dec. 11, 1959. Abstracts were prepared for 15 working papers submitted to the committee covering various aspects of the contamination of foods and agricultural materials by fission products from fall-out. (C.H.)

10340 HAZARD TO MAN ARISING FROM RADIOACTIVE CONTAMINATION OF FOOD AND WATER. R. Lowry Dobson (World Health Organization, Geneva). p.1-5 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

The biological effects of radiation are reviewed. Both genetic and somatic effects are considered. It is pointed out that radioactive materials may enter the body in a variety of ways, but the most common and important from the health standpoint are ingestion and inhalation. The hazards to man arising from radioactive contamination of food and water are summarized. (C.H.)

10341 POTENTIAL RADIOACTIVE CONTAMINATION FROM NUCLEAR INSTALLATIONS. W. G. Marley (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). p.6-17 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

Factors influencing the possibility of the accidental escape of radioactivity from nuclear installations are discussed. The possibility of such radiations being transmitted to humans through the food chain is considered. It is stressed that any measurements for monitoring purposes and any studies that are made to investigate the behavior of radioisotopes in food chains should be made in such a way that the radiation dose in human tissue can ultimately be evaluated. (C.H.)

10342 THE PASSAGE OF THE RADIOACTIVE SUBSTANCES THROUGH FOOD CHAINS INTO HUMAN DIET: GENERAL REVIEW. R. Scott Russell (Agricultural Research Council, Wantage, Berks, Eng.). p.18-49 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

A general survey is presented of circumstances leading to the passage of radioactive substances through the food chain into human diet. Fission products may be released into the biosphere by nuclear explosions, the release of effluent during the normal operation of nuclear installations, or from accidents in such establishments. The material may be discharged into the atmosphere or into water. Primary consideration should be given to the movement through the food chain of isotopes of strontium, iodine, and cesium. Processes by which these isotopes may pass into the diet of man are outlined. (C.H.)

10343 COMPARATIVE LEVELS OF CONTAMINATION OF SOILS, AGRICULTURAL MATERIALS AND FOOD. H. Broeshart and R. F. Reitemeier. p.50-122 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

The levels of radioactive contamination in soils, agricultural products, and food are compared as a factor of time following exposure to radioactive materials. Contamination levels are compared on a regional basis and an attempt is made to establish food chain relationships for radioactive materials. Data are presented on factors affecting levels of contamination in soils, milk, cereals, flour, potatoes and vegetables, feed crops, and animal bones. (C.H.)

10344 THE CONTAMINATION OF VEGETATION WITH STRONTIUM-90 AND CESIUM-137 FROM WORLD-WIDE FALLOUT. R. Scott Russell (Agricultural Research Council, Wantage, Berks, Eng.). p.123-57 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

Levels of world-wide fall-out to 1960 are reviewed. The mechanisms by which Sr^{90} and Cs^{137} enter plants are described and the relative importance of recently deposited Sr^{90} and of the cumulative total for determining present levels in human diet is discussed. It is concluded that the Sr^{90} from world-wide fall-out now present in plants in largely due to the absorption of material which has not passed through the soil. Depending on the nature of plants, direct foliar or floral contamination and plant-base absorption appear to be the major routes of entry. Contamination thus depends on the quantity of fall-out which has recently been deposited rather than the cumulative total so far deposited. Considerable variations occur between different regions and between different seasons in one country. (C.H.)

10345 THE UPTAKE OF STRONTIUM AND CESIUM BY LOWLAND RICE. Kiyoshi Tensho and Shingo Mitsui (Tokyo Univ.). p.158-81 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

The uptake of Sr and Cs by crop plants from the soil is discussed. Results are reported from pot experiments on

the uptake and distribution of Sr^{90} and Cs^{137} in lowland and upland rice, wheat, and broad bean. An unusually high uptake of Ce by lowland rice was found, and an investigation was made of the effect of water-logged conditions and salts on the uptake of Ce from soils. It was concluded that ammonium nitrogen in water-logged paddy fields affects the uptake of Ce. A slight discrimination of Sr against Ca also was found in root uptake by rice plants. (C.H.)

10346 THE BEHAVIOUR OF RADIOACTIVE CONTAMINANTS IN SOILS. A. C. Schuffelen (Agricultural State Univ., Wageningen, Netherlands). p.182-217 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

A knowledge of the behavior of the different radioactive elements in soil is of prime importance since the soil forms an important link in the food chain. The properties of soils and contaminants, exchange reactions concerning radioactive contaminants, the fixation of radioactive contaminants in soil, and the availability of contaminants for plants are discussed. It is concluded that Ce fixation in soil is the most serious problem in contamination of the soil by fission products from fall-out. (C.H.)

10347 THE BEHAVIOUR OF FISSION PRODUCTS IN ANIMALS. R. J. Garner (A.R.C. Field Station, Compton, Berks, Eng.). p.218-31 of "Suplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

The metabolism of fission products by grazing animals is considered as a link in the human food chain. Emphasis is placed on the transfer of fall-out fission products from the diet of a cow to its milk. Of the nuclides absorbed from the gut of a cow and transferred to a significant extent to its milk, I^{131}, Sr^{89}, and Sr^{90} are considered the most important. From 1.3 to 13.1% of carrier-free I^{131} and from 0.17 to 3.9% of carrier-free Sr^{89} were recovered from milk during the 6 days following a single oral dose. The variations in recovery of Sr^{89} were due to variations in milk yield. Factors influencing the secretion of I^{131} and strontium isotopes into milk are discussed. (C.H.)

10348 THE MOVEMENT OF RADIOACTIVE CONTAMINANTS THROUGH AQUATIC FOOD CHAINS. Evidence from the United Kingdom. G. Wortley (Ministry of Agriculture, London). p.232-47 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

Affluent arising from the treatment of used nuclear fuel elements at the Windscale Works is discharged into the sea at a point 3 km from the Cumberland coast. Results are summarized from a 5-year study of the movement of radioisotopes from this affluent through the water-vegetable-animal chain. The discharged effluent was found to be rapidly diluted with large volumes of sea water and carried to and fro along the coast over a distance of several km by the oscillating tidal stream. Beyond the range of this movement, the activity is removed by the process of eddy diffusion and the concentration falls to negligible levels in a few tens of km. Much radioactivity becomes adsorbed onto fine particles of sand, mud, and organic matter in suspension and some of this is deposited onto the sea bed. The activity is taken up by fish and sea weeds. Results of the study show that it would be safe to release some 20,000 c per month of fission products at the point where about 3,000 c per month was released during the study period. (C.H.)

10349 CONTAMINATION OF AQUATIC PRODUCTS BY RADIOACTIVE MATERIALS. Yoshio Hiyama (Tokyo Univ.). p. 248-51 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

The distribution of fission products from fall-out or flow-out from nuclear explosions in sea water is discussed. It is pointed out that the fission products of interest from a health stand-point are those with a long biological half-life in both aquatic organisms and human beings, those having a high concentration factor in edible organisms, and those present in large amounts. These include Sr^{90}, Cs^{137}, Co^{60}, Zn^{65}, Ce^{144}, I^{131}, Ru^{103}, Mo^{99}, Ba^{140}, and isotopes of Fe and Cd. The original forms of the radionuclides when they come into water and the size of the particles influence their uptake by aquatic organisms. The potential hazards from transmission of these fission products in the ecosystem and eventual uptake by the human body are discussed. (C.H.)

10350 THE EFFECT OF FOOD CONSUMPTION HABITS AND PROCESSING ON THE RADIOACTIVE CONTAMINATION OF HUMAN DIETS WITH SPECIAL REFERENCE TO STRONTIUM AND CALCIUM. Dorothy F. Hollingsworth (Ministry of Agriculture, London) and K. K. P. N. Rao. p.252-75 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

The importance of food consumption data in the assessment of the hazards to a population due to consumption of foods contaminated with Sr^{90} and Cs^{137} is discussed. The two main sources of such information are the food balance sheet, which provides information on supplies of foods available at the retail level, and household food consumption surveys, which are based on direct inquiry in the home. Countries of the world are classified into 4 broad categories according to available information on Ca consumption and the importance of milk and its products as sources of dietary Ca. Unusual sources of Ca, the effects of water consumption and analysis, the effects of milling wheat and rice, and the effects of various methods of vegetable preparation on levels of dietary Ca are considered. Methods of using food consumption data to devise monitoring systems and to assess the intake of Ca, stable Sr, Sr^{90}, and Cs^{137} are discussed. It is emphasized that Ca intake should not be used as the sole criterion of Sr^{90} intake and K content of the diet should not be used alone as a guide to the analysis of foods for Cs^{137}. (C.H.)

10351 REMEDIAL MEASURES FOR RADIOACTIVE CONTAMINATION OF FOODS AND AGRICULTURAL MATERIALS. R. F. Reitemeier (U. S. Atomic Energy Commission, [Washington D. C.] and U. S. Dept. of Agriculture, [Washington, D. C.]). p.276-84 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

Radionuclides in the environment enter the food chains of man primarily through the agricultural production of crops. Many foods of plant and animal origin normally are processed in some manner prior to consumption. Modification in methods of production, processing, and consumption of foods for the purpose of reducing the radionuclide content of foods or agricultural materials are discussed.

These include land reclamation and decontamination, changes in farming systems, and livestock management. (C.H.)

10352 FURTHER STUDIES OF REMOVAL OF STRONTIUM AND CESIUM FROM MILK. B. B. Migicovsky (Canadian Dept. of Agriculture, Ottawa). p.295-304 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

Results of a series of laboratory studies indicate that radioisotopes of Sr and Cs can be removed from milk by means of equilibrated ion exchange resins. Changes in cation concentration of the milk are avoided by this method. (C.H.)

10353 METHODS OF SAMPLING TO ASSESS THE CONTAMINATION OF AGRICULTURAL PRODUCTS WITH FISSION PRODUCTS, WITH PARTICULAR REFERENCE TO STRONTIUM-90. F. B. Ellis and E. R. Mercer (Agricultural Research Council, Wantage, Berks, Eng.). p.305-15 of "Supplement to the Report of the FAO Expert Committee on Radioactive Materials in Food and Agriculture." Rome, Food and Agriculture Organization of the United Nations, 1960. (In English)

Sampling methods are described for use in the assessment of the contamination of agricultural products with fission products from fall-out. Consideration is given to methods for measuring the quantity of fission products which are entering the food chain and methods for measuring the total deposition of fission products per unit area of ground. Only the isotopes of Sr, I, and Cs are considered, since they are of most concern from a health viewpoint. The sampling methods are those which have been used in the United Kingdom. It is pointed out that in countries where dietary habits and methods of agricultural production and distribution are different, modifications in the methods may be needed. (C.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

10354 (AECL-1329) GAMMA IRRADIATION IN CANADA. VOLUME 2. (Atomic Energy of Canada Ltd. Commercial Products Div., Ottawa). Oct. 1961. 147p.

Volume I issued as AECL-1120.

A collection of 18 papers is presented which treats the applications and effects of gamma radiation in biology, foods, and chemistry. Separate abstracts were prepared for 11 of the papers; the remaining 7 were previously abstracted in NSA. (D.L.C.)

10355 (AECL-1329(p.13-16)) COULD THIS BE DEATH TO THE CODLING MOTH? M. D. Proverbs and J. R. Newton (Atomic Energy of Canada Ltd. Commercial Products Div., Ottawa). Brit. Columbia Orchardist, 1: No. 4, (1960).

The possibility of using the sterile-male method to control the codling moth was investigated. Both females and males were found to mate more than once frequently. Gamma irradiation was found to be more consistent in the induced sterility results than growth at high temperatures. A high sterility was obtained when male pupae were exposed to 40,000 rad ~1 day before moth emergence, and normal behavior is unaffected until >50,000 rad is reached. About 2% of the eggs resulting from the union of such sterile males and normal females hatch, as compared with ~80% in the control. Irradiation was found to kill female pupae more readily than male pupae, and a dose of 25,000 sterilizes >99% of the eggs that they lay. (D.L.C.)

10356 (AECL-1329(p.17-24)) SOME PUBLIC HEALTH ASPECTS OF THE MICROBIOLOGY OF IRRADIATED FOODS. F. S. Thatcher (Canada. Dept. of National Health and Welfare, Ottawa).

An attempt is made to interrelate some of the known and hypothetical changes within microbial populations of irradiated foods with their potentiality to give rise to public health problems. Since irradiation most likely will be used to prolong the shelf-life of foods, attention is focused on non-sterilizing radiation pasteurization processes. Possible mutation effects on the virulence and toxigenicity of microorganisms are discussed. The problem of induced radiation resistance and selective survival is considered. Viruses are discussed. (D.L.C.)

10357 (AECL-1329(p.25-8); NRC-6243) DESTRUCTION OF ALPHA-TOCOPHEROL BY GAMMA-IRRADIATION. Dyson Rose, H. J. Lips, and R. Cyr (National Research Council, Ottawa). J. Food Sci., 26: 153-5(1961).

Irradiation (Co^{60} source) of solutions of DL-α-tocopherol caused extensive destruction of this vitamin and gave rise to products similar to those obtained by autoxidation. Irradiation in saturated solvents (mineral oil, methyl myristate) destroyed more tocopherol than did irradiation in unsaturated solvents (methyl oleate, methyl linoleate). Destruction by 2.0 Mrad of irradiation increased with increasing tocopherol concentration, but the increase became negligible above 0.5% tocopherol in the saturated and 0.1% tocopherol in the unsaturated solvents. (auth)

10358 (AECL-1329(p.29-37); AECL-1260) THE EFFECTS OF COBALT 60 RADIATION ON TRICHINELLA SPIRALIS IN MEAT. H. C. Gibbs (Macdonald Coll., Quebec), K. F. MacQueen, and J. W. Pullin. Can. J. Public Health, 52: 232-40(June 1961).

A study was made on the effects of various irradiation levels on the survival of trichinae in meat and on the reproductive potential of the survivors. Rats and pigs were used with dose levels of 6,000 to 30,000 rad. The inhibition level as measured by the number of larvae developing to adults in the host was found to be proportional to the irradiation level. At lower irradiation levels (6,000 to 12,000 rad), partial or complete inhibition of the reproductive potential of adult worms was observed. The effect of irradiation on trichinae in meat was independent of the number of larvae in the meat and of the type of meat. It is concluded that the irradiation of pork with gamma rays is an effective means of control of trichinosis in humans and that the dosage range for control is 20,000 to 30,000 rad. (D.L.C.)

10359 (AECL-1329(p.38-41)) EFFECTS OF SODIUM METABISULPHITE, ANTIBIOTICS, AND GAMMA IRRADIATION ON THE SHELFLIFE OF PREPEELED POTATOES AT ROOM TEMPERATURE. E. A. M. Asselbergs (Dept. of Agriculture, Ottawa), W. E. Ferguson, W. P. Mohr, and K. F. MacQueen. Appl. Microbiol., 8: 311-14(Sept. 1960).

Studies were made in an attempt to increase the shelf life of packaged, pre-peeled, sulfite-treated potatoes at room temperature by the separate or combined use of gamma irradiation and antibiotics. Dipping solutions used were sodium metabisulfite, oxytetracycline, and nisin, and irradiation levels were at 100,000 and 300,000 rad. The combined use of 300,000 or 100,000 rad and oxytetracycline controlled bacterial development in potatoes stored for at least 6 days, but color changes and a "storage" off-flavor precludes the use of this technique for commercial use. (D.L.C.)

10360 (AECL-1329(p.42-7); AECL-1207) STUDIES ON THE IRRADIATION OF MICROORGANISMS IN RELATION TO FOOD PRESERVATION. [PART] I. THE COMPARATIVE SENSITIVITIES OF SPECIFIC BACTERIA OF PUBLIC HEALTH SIGNIFICANCE. I. E. Erdman (Dept. of National Health and Welfare, Ottawa), F. S. Thatcher, and K. F. MacQueen. Can. J. Microbiol., 7: 199-205(1961).

The limits of tolerance to gamma irradiation were determined for 21 cultures representative of the following bacterial species of public health significance in foods: Staphylococcus aureus, Escherichia coli (types I and II), Aerobacter aerogenes, A. cloacae, Streptococcus faecalis, Salmonella gallinarum, S. tennessee, Mycobacterium tuberculosis, Clostridium botulinum (typex A and E). A several-fold difference in radiation sensitivity was demonstrated, specific sensitivity being influenced by the nature of the suspending medium during irradiation. Spores of C. botulinum, type A, were more resistant than those of type E, while six strains of staphylococci of differing phage pattern showed closely similar tolerances. The most sensitive species among those tested was M. tuberculosis. The coliform organisms were more sensitive than the salmonellae, which, in turn, were more sensitive than the staphylococci and S. faecalis. Destruction of coliform bacteria in irradiated foods cannot, therefore, be used as an index of adequate pasteurization. Staphylococcal emetic toxin present in pork sausage and suspended in culture filtrates was destroyed by irradiation at comparatively low levels in contradistinction to the findings for the toxin of C. botulinum. (auth)

10361 (AECL-1329(p.48-55); AECL-1208) STUDIES ON THE IRRADIATION OF MICROORGANISMS IN RELATION TO FOOD PRESERVATION. [PART] II. IRRADIATION RESISTANT MUTANTS. I. E. Erdman (Dept. of National Health and Welfare, Ottawa), F. S. Thatcher, and K. F. MacQueen. Can. J. Microbiol., 7: 207-15(1961).

Using a Co^{60} source, repeated irradiation of survivors of bacterial cultures at a level initially destroying a high proportion of cells gave rise to strains which were more resistant to irradiation than the original cultures. Development of resistance was shown in single strains of Escherichia coli, Streptococcus faecalis, and Clostridium botulinum type A, and in one of three strains of Staphylococcus aureus, but not in two strains of C. botulinum type E nor in Salmonella gallinarum. Changes were noted in phage patterns of the staphylococci, biochemical characteristics of E. coli, and toxin production of C. botulinum in response to repeated irradiation. Irradiation of parent and resistant cultures at −78°C did not change their comparative resistance, though each was afforded some protection at this temperature. These findings suggest that the induced resistance is an expression of resistance to the primary effect of irradiation and not to possible toxic substances formed by free-radical interaction. (auth)

10362 (AECL-1329(p.56-68)) GAMMA IRRADIATION OF POTATOES TO INHIBIT SPROUTING. R. F. Errington, K. F. MacQueen (Atomic Energy of Canada Ltd. Commercial Products Div., Ottawa).

An extensive test program was begun in Canada to learn more about the technical and economical aspects of sprout inhibition by irradiation. A mobile, trailer-mounted irradiation facility for treatment of large quantities of potatoes at their storage place is described. Some of the advantages of sprout inhibition are outlined. (D.L.C.)

10363 (AECL-1329(p.69-72)) PREPARATION OF NON-INFECTIVE SOLUBLE ANTIGENS WITH GAMMA RADIATION. John R. Polley (Dept. of National Health and Welfare, Ottawa). Can. J. Microbiol., 7: 135-9(1961).

The use of gamma radiation from a cobalt-60 cell for the preparation of noninfective diagnostic antigens for influenza A, influenza B, mumps, smallpox, and herpes simplex was investigated. It was found possible to destroy the infectivity while retaining most of the complement-fixing activity of all these antigens. The degree of purity of the antigen had no apparent effect on the rate of inactivation, as is the case when formaldehyde is used. Under the experimental conditions described, the degree of inactivation depended on the total amount of radiation applied and not on the dose rate. The kinetics of virus inactivation make it possible to calculate the amount of radiation required to destroy infectivity completely and yet retain most of the antigenicity. If necessary, it is possible to apply an additional calculated amount of radiation to destroy residual infectivity without causing loss of antigenicity. Gamma radiation appears to be superior to formaldehyde treatment for the preparation of the herpes simplex antigen which is particularly sensitive to heat and to formaldehyde. (auth)

10364 (AECL-1329(p.73-90)) ROOM TEMPERATURE STABILIZATION OF RADIATION-PRODUCED FREE RADICALS IN BARBITURIC ACIDS. J. A. R. Cloutier (Dept. of National Health and Welfare, Ottawa). Can. J. Phys., 39: 514-33(Apr. 1961).

Experimental evidence shows that a boric acid glass may be used to stabilize at room temperature organic free radicals produced by radiation in a number of barbituric acid derivatives. The method and the experimental results are discussed. (auth)

10365 (AECL-1329(p.146)) A SELF-CONTAINED IRRADIATION UNIT OF MEDIUM DOSE RATE. (Atomic Energy of Canada Ltd. Commercial Products Div., Ottawa).

A new unit, Gammacell 200, is described which is smaller than Gammacell 220 and has a nominal maximum dose rate of 6.0×10^5 r/hr from a Co^{60} loading of 3000 curies. Data are compared for the 200 and 220 units. (D.L.C.)

10366 (BMI-X-189) RADIOISOTOPE AND RADIATION APPLICATIONS. Quarterly Progress Report. Duane N. Sunderman, ed. (Battelle Memorial Inst., Columbus, Ohio). Jan. 18, 1962. Contract W-7405-eng-92. 20p.

Exploratory and optimization experiments in the use of in-process isotope neutron sources to produce short-lived intrinsic radiotracers were initiated. Flux determinations using manganese sulfate solutions and indium foils were performed. The maximum thermal-neutron flux measured by indium activation was found to be 9.6×10^4 n/(cm^2)(sec) for a 10-curie polonium-beryllium source. The peak flux occurred 3.2 cm from the center of the source through approximately 1.6 cm of water moderator. The study of the mechanism of formation of free radicals in polymeric materials was continued. Again, emphasis was placed on an examination of the effects of structure and molecular weight on the efficiency of free-radical formation in acrylate and methacrylate polymers. In addition, the investigation of the potential application of this information to the development of graft copolymers was continued. (auth)

10367 (NYO-2607) FISSION PRODUCT APPLICATIONS USING GASEOUS BETA SOURCES, TASK I. Final Report. Hoke S. Miller, John H. Zufall, and William G. Marancik (Air Reduction Co., Inc. Central Research Labs., Murray Hill, N. J.). Sept. 1960. Contract AT(30-1)-2343. 53p.

Beta radiation from Kr^{85} initiated the polymerization of styrene in the solid, liquid, and vapor phase. Highest yield of polystyrene was obtained in the liquid phase with the Kr^{85} dissolved in the styrene; under these conditions yields as high as 6.79 grams of polymer per curie per 24 hours were obtained, corresponding to a G-value of about 5,000. Calculated over-all activation energy for the polymerization was 7,500 cal/mole. The polymerization probably proceeds by way of a chain reaction propagated by free radicals. At temperatures from −196°C to 331°C and at pressures up to about 120 cm, fission product krypton with and without catalysts did not influence the oxidation of hydrogen chloride to chlorine and water. Kr^{85} radiation increased the electrical conductivity of gases. Results with typical mono-, di- and triatomic gases are tabulated. Addition of Kr^{85} to the gas in a discharge tube reduces the time lag between the application of voltage and the discharge. Results for concentrations up to 1 curie per liter are tabulated. Laboratory procedures for the handling of Kr^{85} and its recovery from reaction products were developed. (auth)

10368 (QMFCI-14-61) PROCEEDINGS, SEVENTH CONTRACTORS' MEETING, QUARTERMASTER CORPS' RADIATION PRESERVATION OF FOODS PROJECT, CHICAGO, ILLINOIS, 6-8 JUNE, 1961. (Quartermaster Food and Container Inst. for the Armed Forces, Chicago). July 1961. 205p.

This report of the meeting, held June 6 to 8, 1961, at Chicago, Illinois, summarizes technical discussions and speeches presented there covering various phases of the radiation preservation of foods. (auth)

10369 (JPRS-12305) EFFECT OF PRE-PLANTING IRRADIATION OF COTTON SEED BY GAMMA-RAYS OF COBALT-60 ON THE ACCUMULATION AND CHEMICAL COMPOSITION OF COTTONSEED OIL. Kh. U. Usmanov, A. M. Yakubov, R. M. Mirzakarimov, and A. B. Kuchkarev. Translated from Uzbek. Khim. Zhur., Akad. Nauk Uzbek. S.S.R., No. 3, 45-50(1961). 9p.

Irradiation by gamma-rays of seed increased the accumulation of seed oil in cotton bolls. The greatest accumulation occurs at the second to third and at the fifth to sixth sympodial branches. Oil accumulation in the cotton seed depends on the dosages of the pre-planting irradiation of the seed. The optimal dosage can be taken at 6000 to 8000 r. At this value the seed oil content, as a result of separate experiments, was shown to reach a value of 3.21% at the second to third sympodial branches in comparison with the control. The chemical composition and the edible value of oil from cotton seed subjected to pre-planting gamma-irradiation using cobalt-60 at dosages of up to 15000 r practically is unchanged. In the irradiation of cotton plant seed before planting, in seeds possessing high reactivity and the requisite energies for initiating chain reactions, evidently there are formed long-lived free radicals from the radiolysis of water, proteins, and other substances, which is the most probable mechanism for seed growth. Taking into account the positive result of our previous studies with irradiation, indicating an increase in harvest potential of raw cotton, we recommend for introduction into production of pre-planting irradiation of seed using gamma-rays of cobalt-60 in limits of dosages from 6000 to 10000 r. (auth)

10370 (NP-tr-846) TREATMENT OF PEARS WITH X-RAYS AND ELECTRONS. H. Hansen and T. Gruenewald. Translated by F. C. Allen (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Atompraxis, 7: 213-16(1961). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 22606.

10371 ATOMIC ENERGY IN THE RUBBER AND PLASTICS INDUSTRIES. R. Roberts (Wantage Research Lab., Berks, Eng.). Nuclear Energy, 62-7(Feb. 1962).

The application of atomic energy in the plastics and rubber industries is discussed with respect to its aid in production and development of materials. Such topics as backscattering, uniform mixing, sulfur solubility, economic factors, radiation effects, stress cracking, reaction control, grafting, and adhesive strength are briefly discussed when the use of radioisotopes are applied to the processes. (N.W.R.)

ISOTOPE SEPARATION

10372 (K-1455) SOME VALUE FUNCTIONS FOR MULTICOMPONENT ISOTOPE SEPARATION–APPLICATION TO A UNIT COST SCALE FOR URANIUM-235, 236, 238 MIXTURES. A. de la Garza, G. A. Garrett, and J. E. Murphy (Oak Ridge Gaseous Diffusion Plant, Tenn.). July 19, 1960. Contract W-7405-eng-26. 76p.

A theoretical study is presented of multi-component isotope separation cascades. A theory is developed which leads to the multi-component analog of a two component ideal cascade. The multi-component analog is a matched abundance ratio cascade. Multi-component analogs are derived for value functions, separative work, and various relationships of importance in two component isotope separation cascade theory. The theory is applied specifically to the derivation of a multi-component cost formula which could be used to price U containing U^{236}. (This cost formula is derived merely as an illustration of the theory and no recognition or commitment on the part of the USAEC is implied.) The multi-component matched abundance ratio cascade does not minimize total cascade flow as does the two component ideal cascade. It is found, however, that for U isotope separation the total flow in the matched U^{235}/U^{238} abundance ratio cascade exceeds the minimum by an insignificant fraction for a wide range of U^{236} concentrations. (auth)

10373 CONTRIBUTION TO ISOTOPE ENRICHMENT BY DUAL-TEMPERATURE METHOD. Josef Priebsch (Osterreichische Stickstoffwerke Aktiengesellschaft, Linz/Donau, Austria). Acta Phys. Austriaca, 14: 347-57 (1961). (In German)

Isotopic enrichment using the dual-temperature process is discussed. The mathematical formulation of the exchange process and the distillation process is indicated, and the optimization problems of various components and stages are reviewed. (J.S.R.)

10374 SEPARATION OF STABLE NITROGEN ISOTOPES BY ION EXCHANGE CHROMATOGRAPHY. M. Urgell Comas, T. Batuecas Rodriguez, F. de la Cruz Castillo, and R. Fernández Cellini (Junta de Energia Nuclear, [Madrid]). Anales real soc. espăn. fís. y quím. (Madrid), Ser. B, 57: 587-94(Sept.-Oct. 1961). (In Spanish)

The separation of stable isotopes of nitrogen in ammonium compounds by ion exchange, using Dowex 50-W, was studied. The separation factor, the frontal coefficient of enrichment, the break critical volume at different concentrations, and flow rates using the break-through chromatographic method were determined. The influence of different anions on the efficiency of the process was investigated. (auth)

10375 EFFECTS OF OXYGEN ON CATALYTIC ACTIVITY OF Pt FILMS IN HYDROGEN ISOTOPIC EXCHANGE REACTION. G. K. Boreskov and A. A. Vasilevich (Karpov Inst. of Physics and Chemistry, USSR). Kinetika i Kataliz, 2: 679-89(Sept.-Oct. 1961). (In Russian)

Effects of platinum film poisoning by oxygen on hydrogen adsorption and isotopic exchange are studied. It is shown that with increased oxygen adsorption the amount of hydrogen adsorption drops. Additions of small amounts of oxygen do not influence the adsorptive or catalytic properties of the film. Considerable additions of oxygen do not change the rate of hydrogen exchange at unoccupied points. (R.V.J.)

10376 AN ENRICHMENT EFFECT OF OXYGEN IN THE ISOTOPE OXYGEN-18 OBTAINED DURING AN EXPERIMENT WITH CONCENTRATED OZONE. M. Servigne, F. Mahieux, and P. Vernotte (Institut National Agronomique, Paris). Nature, 193: 775-6(Feb. 24, 1962).

A process for preparing concentrated O_3 from O_2 comprises the steps of forming dilute O_3 in the initial O_2 gas by electrical discharge, dissolving O_3 selectively in cold liquid $CFCl_3$, and evaporating fairly pure O_3 on careful heating of the solution. Samples of the initial O_2 and of the final evaporated oxygen were subjected to mass spectrographic analysis, and the separation coefficient α of O^{18} was found to be 1.07 for the process. A series of samples of the final oxygen taken at different times during the evaporation of O_3 gives the same value of α, which indicates that the evaporation does not take part in the O^{18} enrichment. (D.L.C.)

MATHEMATICS AND COMPUTERS

10377 (APEX-663) ISOTHERMALIZE—A COMPUTER PROGRAM TO SIZE COOLANT PASSAGES. S. C. Skirvin (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Feb. 1962. Contracts AF33(600)-38062 and AT(11-1)-171. 202p.

This program is an extension of the General Flow Passage computer program described in APEX 664. It will systematically vary two of the normally independent input variables in a compressible flow loss analysis so as to satisfy specified values of certain quantities, notably maximum surface temperature and exit pressure level, which are normally dependent variables. In some of the 10 input options, a characteristic dimension associated with the flow channel cross section is one of the independent variables which will be computed in this fashion. The earlier program could vary only one independent variable in this fashion. (auth)

10378 (APEX-664) GENERAL FLOW PASSAGE: A COMPUTER PROGRAM TO CALCULATE AEROTHERMAL PERFORMANCE OF AN ARBITRARY FLOW PASSAGE OF FIXED GEOMETRY. S. C. Skirvin (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Oct. 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 254p.

The General Flow Passage computer calculates the one-dimensional aerothermal performance of a compressible flow passage of arbitrary geometry. The program computes over-all temperature and pressure levels as well as local axial pressure and surface temperatures. It will accommodate non-frictional pressure loss coefficients at axial locations as well as at entrance and exit. Both laminar and turbulent flow are treated and internal expansion and contraction losses can be computed by the program. Almost any likely combination of flow and temperature data is acceptable as input data, such as maximum surface temperature or pressure drop. Heat transfer "boundary conditions" are tailored for nuclear heat transfer problems, but not irremediably so. (auth)

10379 (APEX-702) PROGRAM ODD—A ONE-DIMENSIONAL MULTIGROUP CODE FOR THE IBM-7090 (ANP PROGRAM NO. 657). P. G. Fischer, F. D. Wenstrup, and T. A. Hoffman (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 30, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 197p.

The physical and mathematical reactor models which are used in Program ODD are discussed. In addition, the FORTRAN II source program listings, decimal data input sheets, and input and output for a sample case are given. Program ODD was designed to make use of the Revised Nuclear Data System at ANPD which consists of twenty-five energy group cross-section data including high energy inelastic scattering matrices, resonance parameters for the resolved resonances, and thermalization scattering matrices for the near thermal energy region. The most unique aspect of the program is the mathematical technique employed for eliminating inner iterations and slow convergence rates occasioned by the "up-scattering" in the thermalization region of the energy lattice. Direct inversion of the energy matrix coupling the thermal and last four epithermal groups provides simultaneous consistent solutions for these groups within each power iteration. (auth)

10380 (CRT-867) PROGRAMMING METHODS FOR THE CHALK RIVER DATATRON. L. L. Larson, ed. (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Nov. 1961. 95p. (AECL-1410).

A manual of instruction for preparing programs for the Burroughs 205 (Datatron) computer is presented. It includes a revised and enlarged version of the material contained in CRT-671 (Programmer's Guide to the Chalk River Datatron) and a revised version of CRT-916 (ACE—An Algebraic Compiler and Encoder). New sections were written to give a more complete description of the computer and its peripheral equipment and to describe the coding system known as SAP (Symbolic Address Programming). The final section consists of reference tables summarizing commands, codes, and procedures. (auth)

10381 (DC 56-12-105) 650 PROGRAM FOR CALCULATION OF SYMMETRIC THERMAL STRESSES IN THIN CONES. B. Kaplan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 7, 1956. Contract AT(11-1)-171. 20p.

The digital technique for computing symmetric thermal stresses in thin cones which are subjected to an axially symmetric temperature distribution with the I.B.M. 650 is presented. In addition to the stresses, the output of the program also consists of the related forces, moments, and displacements. The computations are based upon equations for the particular solution, which were obtained from DC 55-11-127. The machine time required is slightly less than ten minutes per run, including loading time. (auth)

10382 (DC 57-1-19) PROGRAM FOR EVALUATION OF THE EXPONENTIAL INTEGRAL ON THE IBM 650 COMPUTER. A. J. Ness (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). September 1, 1956. Contract AT(11-1)-171. 18p.

A program is presented for evaluation of the exponential integral, $E_n(x) = \int_1^\infty (e^{-xt}/t^n)\,dt$, on the IBM 650 Computer. An accuracy of five significant figures is assured. A computation requires no more than thirty seconds of machine time. (auth)

10383 (DC-58-4-128) APPLICATION OF IBM 650 COMPUTER TO SERVO ANALYSIS. J. W. Ryan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 17, 1958. Contract AT(11-1)-171. 70p.

An IBM 650 digital computer technique for obtaining open and closed loop frequency responses and complex plane plots for linear servo systems is presented. (auth)

10384 (DC 58-8-708) ANALYSIS OF IN-PILE TEST SAMPLES USING THE "650 PROGRAM FOR OFF-DESIGN PRESSURE LOSS CALCULATIONS." D. J. Holtslag and D. J. Liffengren (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 8, 1958. Contract AT(11-1)-171. 13p.

A method of analyzing the aerothermodynamic performance of in-pile fuel element assemblies is presented. Maximum, minimum, and average longitudinal sample temperatures are evolved by this method of analysis. In addition, an orderly method for determining transverse power profiles from flux wire measurements is presented. (D.L.C.)

10385 (DC-59-1-89) NUMERICAL AND DIGITAL PROGRAM ANALYSIS FOR RESPONSE OF PNEUMATIC AMPLIFIER—EA PROBLEM NO. 7-1072—JOB NO. 50960—ANP PROGRAM NO. 154. J. A. Delaney (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). January 2, 1959. Contract AT(11-1)-171. 51p.

A 704 digital computer program is presented which solves numerically the set of differential equations describing the transient response of a high temperature pneumatic amplifier under conditions of isothermal operation. The fourth order Runge-Kutta Method is used in the solution. The program is an attempt to handle on a digital computer, the analysis of the type of system usually investigated with analogue equipment due to the discontinuities in the functions. (auth)

10386 (DC-59-8-217) PRELIMINARY REPORT – GENERALIZED 704 PROGRAM FOR LINEAR SYSTEM ANALYSIS. J. W. Ryan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 19, 1959. Contract AT(11-1)-171. 61p.

The necessary information to allow usage of a generalized IBM 704 digital computer program for linear system analysis is presented. At the option of the design engineer, the program will calculate the equivalent system polynomials, the frequency response (Bode and Nyquist coordinates), root loci data, and transient response for a given system that is described in transfer function notation. (auth)

10387 (DC 59-12-82) FORTRAN TRAINING MANUAL. R. A. Pastore (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 15, 1959. Contract AT(11-1)-171. 43p.

This report fulfills the requirements for MILESTONE II, of the COMPUTER TECHNIQUES DEVELOPMENT TASK, 50155. The primary purpose of this manual is to fulfill a need for a text in conducting Fortran Programming Courses. It provides for the student at least three necessary features not immediately available elsewhere: 1. Numerous examples of the uses of the Fortran statements in addition to elaboration of definitions provided in the Fortran Reference Manuals. 2. Exercises for the student to test his understanding of the subject matter. 3. Specifications for using the Fortran system which is available at ANPD as distinct from the Fortran system described in IBM Reference Manuals. (auth)

10388 (DC-59-12-123) MAGNETIC LOGIC DEVICES. John L. Scharf (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 14, 1959. Contract AT(11-1)-171. 21p.

The function, theory, development, and operation of three magnetic logic devices are described. The devices are a variable limiter, a signal selector, and a magnetic rectifier. (auth)

10389 (DC 60-1-159) LEAST SQUARES FIT INCLUDING ESTIMATE OF ERROR IN PARAMETERS. H. S. Drew (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 20, 1960. Contract AT(11-1)-171. 28p.

A program written in FORTRAN automatic coding system for an IBM 704 digital computer is described. It computes the parameters a, b, and c for a quadratic equation, $y = a + bx + cx^2$, to be fit to experimental data points. The data points to be used have uncertainties in the "y" direction which are considered in the statistical analysis by the program. The program also computes the standard deviation of y from the fitted curve, chi-square, the deviation of a, b, and c due to statistical methods used, and the deviation of a, b, and c with correction made for the uncertainties in the y_i's. (auth)

10390 (GA-2492) SUMMIT – AN IBM-7090 PROGRAM FOR THE COMPUTATION OF CRYSTALLINE SCATTERING KERNELS. Joan Bell (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Feb. 1, 1962. Contract AT(04-3)-314. 113p.

SUMMIT is an IBM-7090 FORTRAN program for calculating crystalline scattering kernels. The purpose of the program is to evaluate the differential energy transfer cross section for scattering by a crystalline material. The method of solution, input preparation, printed output, punched card output, flow of program, special coding techniques, and computing time are discussed. (M.C.G.)

10391 (HW-71812) QUICK – A SIMPLIFIED FUEL COST CODE. E. A. Eschbach, D. E. Deonigi, and S. Goldsmith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 2, 1962. Contract AT (45-1)-1350. 82p.

The QUICK computer code provides a means of calculating total fuel cost for practically all fuel cycles used in thermal, fast, breeding, and non-breeding reactors. The code breaks down fuel cost into nine basic cost elements which are associated with discrete processes in the fuel cycle. Thus, the effect on fuel cost of varying any one or more of these elements may be determined. The mathematical formulation of each element of cost used in the computer program is presented. The input data to the QUICK code are grouped in five categories which describe the reactor, out-of-reactor processes, price schedule, physics characteristics, and economic parameters. Eighteen different sets of data describing the economic parameters and nine sets of data describing the physics characteristics can be handled by the QUICK code in one IBM 7090 run. The results obtained with the QUICK code are illustrated by an example case. Machine printouts of the computer program for QUICK and of the example case results are also presented. (auth)

10392 (ORNL-3198) NIGHTMARE – AN IBM 7090 CODE FOR THE CALCULATION OF GAMMA HEATING IN CYLINDRICAL GEOMETRY. M. L. Tobias, D. R. Vondy, and Marjorie P. Lietzke (Oak Ridge National Lab., Tenn.). Feb. 26, 1962. Contract W-7405-Eng-26. 40p.

The NIGHTMARE program calculates the gamma-dose rate at any point in or near a reactor by means of the NDA buildup-factor method. The source distribution is obtained from a two-group, two-dimensional diffusion code (EQUIPOISE-2). Seven gamma-energy groups are used. As many as nine different concentric cylindrical regions may be considered, but only radial variation of attenuation and buildup properties is permitted. Two schemes of estimating buildup factors through a succession of materials are built into the code, and results may be obtained by using either or both methods. An IBM 7090 computer with seven tape units is required. Computations are performed at the approximate rate of 10,000/n mesh points per minute, where n is the number of axial, radial, and angular increments. The program is run under the control of the IBM 7090 MONITOR system. (auth)

10393 (ORNL-3199) EQUIPOISE-3: A TWO DIMENSIONAL, TWO-GROUP, NEUTRON DIFFUSION CODE FOR THE IBM-7090 COMPUTER. T. B. Fowler and M. L. Tobias (Oak Ridge National Lab., Tenn.). Feb. 21, 1962. Contract W-7405-Eng-26. 36p.

EQUIPOISE-3 is an IBM-7090 FORTRAN programmed code for the solution of two-group, two-dimensional, neutron diffusion equations. A maximum of 2100 mesh points may be used, and the code will solve problems in either rectangular or cylindrical geometry. Logarithmic derivative boundary conditions are allowed, and removal of neutrons from both groups is permitted. Adjoint fluxes with the associated flux-adjoint flux regional integrals may be calculated automatically if desired. A constant buckling, group-dependent buckling, or region-dependent buckling may be specified for rectangular geometry. This program is intended to fill the

need for a rapid two-dimensional calculation suitable for survey calculations. During the iterative part of the computations, all operations are carried out in the core memory. The magnetic tape memory is used only for input, output, and program storage. The running time for a 1000-point problem requiring 100 iterations would be about 3 min.(auth)

10394 (ORNL-3200) THE TWENTY GRAND PROGRAM FOR THE NUMERICAL SOLUTION OF FEW-GROUP NEUTRON DIFFUSION EQUATIONS IN TWO DIMENSIONS. M. L. Tobias and T. B. Fowler (Oak Ridge National Lab., Tenn.). Feb. 21, 1962. Contract W-7405-Eng-26. 36p.

The TWENTY GRAND program for the IBM 7090 is capable of solving neutron diffusion problems in cylindrical or slab geometry for one to six groups. Up to 3000 mesh points may be used. Neutron transfer from any group to any other group is permitted. Leakage in the third dimension in X-Y geometry may be treated by a buckling which can vary with region and group. Three types of symmetry conditions may be handled automatically. The zero flux, zero derivative, and logarithmic boundary conditions are available. Normalization of fluxes to an arbitrary input power is allowed. The fission source distribution and the adjoint fluxes and associated integrals may be computed at the user's option. The number of mesh sweeps permitted is stated as input. The average running time in seconds per iteration per group is approximately 0.0035. (auth)

10395 (WAPD-T-1182(Rev.1)) SIMPLIFIED SPHERICAL HARMONICS EQUATIONS AND THEIR USE IN SHIELDING PROBLEMS. E. M. Gelbard (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1961. Contract [AT(11-1)-Gen-14]. 16p.

Presented at the Winter Meeting of the American Nuclear Society, San Francisco, California, December 12-14, 1960.

In all geometries the spherical harmonics equations can, under special circumstances, be recast as coupled diffusion equations. Conditions necessary for the validity of this transformation are discussed. When the transformation is not rigorously valid, it may nevertheless yield a useful and accurate approximation to the spherical harmonics equations. The approximate equations seem to be adequate for the treatment of shielding problems. (auth)

10396 (WAPD-TM-286) AN APPRAISAL OF THE MIM AND ART DIFFERENCING METHODS EMPLOYING M0076, A DIGITAL FREQUENCY ANALYSIS PROGRAM. J. V. Reihing, Jr. and W. G. Clarke (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Dec. 1961. Contract AT(11-1)-Gen-14. 99p.

An appraisal of the numerical analysis differencing methods employed in the Bettis MIM and ART thermal transients programs is described. The evaluations are primarily conducted by the analysis of certain crucial frequency responses which characterize the differencing techniques. Transient data are also presented to demonstrate the correlation between the frequency and time domain behavior. The merits of the MIM system relative to the ART system as measured by frequency response criteria are demonstrated. M0076, a Philco 2000 FORTRAN-ALTAC program designed to compute the pertinent transient and frequency data is described in detail. The applicability of the M0076 program to other differencing tests and to reactor stability studies is indicated. (auth)

10397 (JPRS-12674) MODERN METHODS OF PRODUCING HEAVY WATER. Ya. M. Varshavskii (Varshavskiy) and S. E. Vaisberg (Vaysberg). Translated from Khim. Nauka i Prom., 4: 498-509(1959). 35p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 2644.

10398 REMARKS ON THE DERIVATION OF THE LORENTZ TRANSFORMATION. E. M. Dewan (Air Force Cambridge Research Labs., Bedford, Mass.). Nuovo cimento (10), 22: 943-57(Dec. 1, 1961). (In English)

An attempt is made to replace the principle of relativity in the derivation of the Lorentz transformation by an alternative postulate concerning the behavior of clocks. It will be shown by means of thought experiments that this postulate is not quite sufficient to obtain the Lorentz transformations and that an additional postulate concerning the absence of length contraction of a rod in the direction normal to its motion (proved indirectly via the Ives-Stilwell experiment) is needed to complete the derivation. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

10399 (ASD-TR-61-322) MATERIALS SYMPOSIUM SEPTEMBER 13-15, 1961, HOTEL WESTWARD HO, PHOENIX, ARIZONA. (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). July 1961. 1000p.

Included are 54 papers presented at the Materials Symposium on research in space environs, structural materials, electronic material requirements, space vehicle power requirements, and improving the mutual guidance and support between the fields of materials and design. Separate abstracts were prepared for 29 papers. (B.O.G.)

10400 (ASD-TR-61-322(p.1-7)) SPACE ENVIRONMENT. M. B. Gilbert (Air Force Cambridge Research Labs., Bedford, Mass.).

A description is given of the natural space environment in terms of solar phenomena, solar corpuscular emission, Van Allen zones, cosmic rays, solar electromagnetic radiation, magnetic fields in the solar system, drag and sputtering, and meteors. Flux measurements made by various earth satellites are discussed. (B.O.G.)

10401 (ASD-TR-61-322(p.8-24)) STRUCTURAL MATERIALS. B. Chasman (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

Projected requirements are described for the development of structural materials applicable to suborbital, orbital, and extraorbital space flights. The construction of present materials toward meeting the development requirements are discussed for strength, light weight construction, and resistance to extreme temperatures. (B.O.G.)

10402 (ASD-TR-61-322(p.25-39)) A NEW LOOK AT SUPERALLOYS. Lawrence F. Bubba (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A review is presented of the development of superalloys from nickel-base, cobalt-base, and chromium–iron–nickel-base alloys. Nominal compositions of some cobalt- and nickel-base superalloys are tabulated. Stress-rupture properties are discussed. Graphical representations are included of other mechanical properties of the superalloys. (B.O.G.)

10403 (ASD-TR-61-322(p.40-54)) STRUCTURAL MATERIALS TO 1800°F (STEEL AND TITANIUM). P. L. Hendricks (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A discussion is given of the properties of low alloy martensitic steels, hot-worked die steels, stainless steels, iron-base alloys containing 20 to 25% nickel, and titanium alloys for applications to 1200°F. Graphical comparisons are included of the properties of the alloys. (B.O.G.)

10404 (ASD-TR-61-322(p.57-77)) GRAPHITE. Ray H. Wilson (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A review is presented of the development of graphite as it applies to Air Force materials applications. The properties are discussed to establish the trends and potentials of the material in meeting aerospace requirements. (B.O.G.)

10405 (ASD-TR-61-322(p.79-98)) PLASTICS, ADHESIVES, AND COMPOSITE MATERIALS. F. W. Kuhn, G. P. Peterson, and R. C. Tomashot (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

The development and properties of the materials according to the individual material components, uses, and composite processes are discussed. An outline is included of research areas requiring continued research for the production of the best possible structural plastics and adhesives. Graphical representations are given illustrating the properties of the materials. (B.O.G.)

10406 (ASD-TR-61-322(p.101-18)) PROTECTION OF REFRACTORY METALS AGAINST ATMOSPHERIC ENVIRONMENTS. N. M. Geyer (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

The characteristics of the oxidation reactions of the metals are reviewed to illustrate the depth of the oxidation protection problem. The development of coatings and coating techniques for the protection of the metals is discussed. Oxidation rates and surface recession at 2000°F for molybdenum, niobium, tantalum, and tungsten are shown and compared with chromium. (B.O.G.)

10407 (ASD-TR-61-322(p.121-39)) VAPOR PRESSURE MEASUREMENT. Paul W. Dimiduk (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

The Knudsen effusion method and the Langmuir technique for measuring vapor pressures are described. Methods applicable to the analysis of the vapor above the materials in the determination of the equilibrium points are discussed. Illustrations are included with descriptions of equipment currently in use showing the compromises made in making the vapor pressure measurements. (B.O.G.)

10408 (ASD-TR-61-322(p.140-51)) THE THERMODYNAMICS OF ABLATION. Emile Rutner (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

The phenomenon of ablative cooling is discussed as a means of illustrating the type of transport and thermodynamic data required for determining the rate of ablation of a given system as a function of heat flux. The problem outlined assumes a heat flux flowing across a gas boundary layer to the surface of a solid body. The most general problem involves two fluid boundary layers (the gas-solid layer and the liquid-solid layer) and is treated by separating the interactions of the two interfaces. Equations are listed and a discussion is given of techniques for evaluating the quantities necessary to solve the problem. (B.O.G.)

10409 (ASD-TR-61-322(p.307-36)) REFRACTORY METALS AS ENGINEERING MATERIALS. T. D. Cooper (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A review is presented of the development and properties of molybdenum, niobium, tantalum, and tungsten alloys for application as engineering materials in aerospace vehicles. The discussion is given in terms of applications, state of the art, refractory metal property problems, processing problems, process control, alloy development, fundamental work, and other needs. (B.O.G.)

10410 (ASD-TR-61-322(p.339-55)) AEROSPACE WORKING FLUIDS. David A. Kirk, John Roth, and Harold Adams (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

The survey of the development, properties, and uses of the various fluids in aerospace systems is given in terms of heat transfer and working fluids, liquid metals and salts, flotation fluids, and hydraulic fluids. It is pointed out that fluid synthesis of nonmetallic materials and property studies for liquid metals and salts are areas requiring research and development in all fluid classes. (B.O.G.)

10411 (ASD-TR-61-322(p.356-81)) AEROSPACE LUBRICANTS. Harold W. Adams (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

The development, properties, and uses of liquid lubricants, greases, and solid films for the efficient and reliable lubrication of power systems, control systems, and their subsystem components in aerospace applications are reviewed. Current research efforts in the development of solid film lubricants for uses to 1000°F are discussed. (B.O.G.)

10412 (ASD-TR-61-322(p.382-90)) ADVANCED LUBRICATION TECHNIQUES. C. A. Beane (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A discussion is given of developments toward meeting anticipated lubrication requirements for liquid rocket engines and flight vehicle power equipment. The areas of lubrication development include propellant lubrications, positive displacement lubrication, lubricating powders entrained in gases, gas-lubricated bearings, liquid metal lubrication, and vapor bearing lubrication. (B.O.G.)

10413 (ASD-TR-61-322(p.393-421)) ELASTOMERS. W. E. Gibbs, W. R. Griffin, and R. G. Spain (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

The developments in the elastomer research program are summarized for synthesis, characterization, and engineering. Synthesis studies include the preparation of new polymers which behave in accordance with accepted definitions of elastic behavior and have such properties as thermal stability, solvent resistance, retention of mechanical properties over a wide temperature range, and radiation resistance. The characterization of the new polymer is made for the physical nature, reactivity toward cross-linking agents, compatibility with reinforcing fillers, and needs for stabilizers and inhibitors to determine the chemical, physical, and mechanical properties. Recommendations are made concerning deficiencies or undesirable properties. The engineering studies are applied to provide elastomeric materials suitable for fabrication into components resistant to the environs of aerospace systems. (B.O.G.)

10414 (ASD-TR-61-322(p.436-55)) ENVIRONMENTAL CONSIDERATIONS FOR THERMAL PROTECTIVE COATINGS. R. M. VanVliet and J. J. Mattice (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

Those elements of space environments are pointed out which are of concern to the proper performance of the coatings and considerations are given of the major interactions resulting from such exposures. The progress and challenges concerned with achieving reliable coating systems are reviewed. Suggested approaches to potentially fruitful areas of study are emphasized. (B.O.G.)

10415 (ASD-TR-61-322(p.482-502)) REFRACTORY EMISSIVE COATINGS. L. N. Hjelm (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

Developments are discussed for coatings applicable to vehicle structures for long time or repeated use at high temperatures. The systems useful to 3000°F are the coated molybdenum and niobium alloy systems and coated graphite. Those useful above 3000°F are generally the refractory oxides in various composite designs. (B.O.G.)

10416 (ASD-TR-61-322(p.505-13)) THE EFFECT OF RADIATION ON SOLID STATE MATERIALS AND DEVICES. Bernard Manning (Air Force Cambridge Research Center, Bedford, Mass.).

The radiation effects are reviewed in terms of radiation interactions, types of radiation effects, radiation protection methods, and radiation environments. Radiation compatibilities are discussed for such electronic devices as resistors, varistors, capacitors, transformers, infrared detectors, and transistors. (B.O.G.)

10417 (ASD-TR-61-322(p.514-31)) RADIATION CHEMISTRY. Roger E. Rondeau and Jack Radell (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A summary is presented of the present knowledge of reaction mechanisms in radiation chemistry, especially as they apply to simple organic compounds. Fundamental concepts are described for types of ionizing radiations, initial events, energy distributions, and phase effects. Discussions of molecule activations in radiation fields, excited species, free radicals, ion radicals, and ion-molecule reactions are given. Past, present, and future applications of the radiation chemistry studies are discussed. (B.O.G.)

10418 (ASD-TR-61-322(p.532-8)) RADIATION EFFECTS ON MATERIALS IN SPACE. R. L. Hickmott, G. H. Griffith, V. L. Donlan, O. V. P. Sessoms, and T. W. Bailey (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A survey is given of the radiation effects situations expected in manned and unmanned missions in space. The two types of radiations under consideration are from reactors and from natural radiations in space. Discussions are included for shielding and effects of natural space radiation on materials. (B.O.G.)

10419 (ASD-TR-61-322(p.563-86)) UNIQUE METALLIC MATERIALS AND TECHNIQUES. E. M. Kennedy, Jr. and S. A. Worcester, Jr. (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A survey is presented of developments in the production of unique metallic materials with adequate strength and corrosion resistance for use at temperatures in excess of 1800°F and having a maximum structural strength with a minimum of weight. The metals investigated include beryllium, scandium, yttrium, and the rare earth metals. The development techniques employed included application of high static and dynamic pressures and ultra rapid quenching. (B.O.G.)

10420 (ASD-TR-61-322(p.589-601)) MATERIALS PROBLEMS IN DYNAMIC ENERGY CONVERSION SYSTEMS. George E. Thompson (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A review is presented of fundamental design and material problems involved in the successful development of a dynamic space power system. A quantitative approach is used and two specific examples, collectors and radiators, are used to illustrate some of the design and material problems. (B.O.G.)

10421 (ASD-TR-61-322(p.602-8)) TYPES OF THERMIONIC POWER CONVERTERS AND CURRENT MATERIALS LIMITATIONS. E. F. Redden (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

The discussion of the types and materials limitations of thermionic power converters surveys and advantages and disadvantages of thermionic generators, the classification of converters according to methods of space charge neutralization, design characteristics, and materials under investigation for the development of cathodes is given. A description is included of the characteristics of the cesium-filled thermionic converter. (B.O.G.)

10422 (ASD-TR-61-322(p.615-35)) MATERIALS FOR ENERGY CONVERSION SYSTEMS. B. Rubin (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A survey is made of materials research and development efforts toward synthesizing and developing into useful forms materials with potential for broad usage and the character-

ization of mechanical, thermal, optical, and electrical properties over wide temperature ranges. Areas requiring continued research emphasis and new research are indicated. (B.O.G.)

10423 (ASD-TR-61-322(p.636-50)) FLIGHT VEHICLE POWER. Donald P. Mortel (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

The discussion includes a definition of flight vehicle power, a description of methods to be used for energy conversion, and forecasts of future power requirements and conversion methods considered likely to be an optimum for application to the various types of future missions. Power system materials problems are presented that result from the space environment and the respective system operating features. (B.O.G.)

10424 (ASD-TR-61-322(p.661-76)) WELDING AND BRAZING SPACE AGE METALS. R. Bowman (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A review is presented of the major problems in welding and brazing metals used in aircraft and missile components including beryllium, titanium, high-strength steel, precipitation hardening stainless steel, heat-resisting alloys, nickel-base alloys, and the refractory metals and alloys. Areas are indicated where further developments are desired in the welding and brazing properties of the metals. (B.O.G.)

10425 (ASD-TR-61-322(p.679-709)) CERAMICS AND INTERMETALLICS. I. D. Latva (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A survey is made of developments, applications, and future requirements of refractory ceramics and intermetallic compounds of interest in aerospace structural and nonstructural components. The materials discussed include borides, carbides, beryllides, nitrides, silicides, and oxides. Brittle behavior and effects of microstructure of the materials are discussed. (B.O.G.)

10426 (ASD-TR-61-322(p.711-37)) ORGANIC AND INORGANIC FIBROUS MATERIALS. J. H. Ross (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A survey is presented of the developments in the research on fibrous structures toward the affecting of optimum low or zero porosity materials for decelerators and other devices that could advantageously be fabricated from fibers which are resistant to temperatures to 2000°F. The research program is divided into three broad areas: fiber drawing and modification; fibrous structural materials; and coatings for fibers and fibrous materials such as polymers, metallic oxide impregnated polymers, and metals. (B.O.G.)

10427 (ASD-TR-61-322(p.817-32)) EXTRUSION OF HIGH TEMPERATURE MATERIALS. Paul S. Duletsky (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A survey is given of the developments in extrusion techniques for the fabrication of alloys of molybdenum, niobium tantalum, and tungsten for high-temperature applications. (B.O.G.)

10428 (ASD-TR-61-322(p.885-98)) BERYLLIUM RESEARCH AND DEVELOPMENT. S. S. Christopher (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

A discussion is given of developments in the research conducted in the brittleness, joining, fabrication of wrought products, and the evaluation of the structural integrity of beryllium products. A review is included of the properties of beryllium which make it attractive to the Air Force as a structural material. Factors preventing the widespread use of the material are summarized. (B.O.G.)

10429 (BM-RI-5934) PRODUCTION OF MOLYBDENUM METAL BY MAGNESIUM REDUCTION OF MOLYBDENUM OXIDES. T. T. Campbell, F. E. Block, and E. R. Andersen (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Jan. 1961. 24p.

In an investigation it was determined that high-purity ductile Mo can be prepared by the Mg reduction of MoO_3 in steel bombs with reaction efficiencies of 95%. The metal purity ranged from 99.2 to 99.8%. (J.R.D.)

10430 (CRRM-1065) THE PREPARATION OF ALUMINUM–URANIUM ALLOYS BY THE ALUMINUM REDUCTION OF URANIUM DIOXIDE. J. Baird and O. J. C. Runnalls (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1961. 14p. (AECL-1418)

Preparation of Al–U ingots by Al reduction of UO_2 for use as NRX fuel elements is described. After separation from slag, the billets were cast into forms for extrusion. The castings were nonporous and homogeneous. (J.R.D.)

10431 (DC-60-6-57) CHROMEL-ALUMEL FLATTENED, "SEALED-SHEATH" THERMOCOUPLE FABRICATION AND LIFE TESTING. J. F. Been (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 7, 1960. Contract AT(11-1)-171. 18p.

Tests which were conducted in the laboratory to determine the endurance characteristics of specially fabricated Chromel-Alumel metal-sheathed thermocouples at 1800 to 2000°F. The results of these tests and the thermocouple junction fabrication procedures are described. (auth)

10432 (EOS-1592-2M-3) HIGH TEMPERATURE SEMICONDUCTING COMPOUNDS FOR THERMOELECTRIC GENERATION. Bi-Monthly Progress Report No. 3, April 15–June 15, 1961. C. B. Jordan (Electro-Optical Systems, Inc., Pasadena, Calif.). June 30, 1961. Contract NObs-84327. 5p.

Development of a synthesis method is reported in which all compounds are synthesized by separate operations then melted in the high-pressure furnace. Compounds such as ThSe, $ThSe_2$, ThTe, $ThTe_2$, US, US_2, USe, and USe_2 were prepared using this procedure. Plans for development of semiconductor evaluation methods are described. (J.R.D.)

10433 (EOS-1592-2M-4) HIGH TEMPERATURE SEMICONDUCTING COMPOUNDS FOR THERMOELECTRIC POWER GENERATION. Bi-Monthly Progress Report No. 4, June 15–August 15, 1961. C. B. Jordan (Electro-Optical Systems, Inc., Pasadena, Calif.). Aug. 30, 1961. Contract NObs-84327. 10p.

Measurements of electric resistivity and Seebeck coefficient were made on ThS, ThSe, ThTe, US, USe, and UTe from room temperature to about 1000°C. Further work is also reported on analytical methods for synthesized semiconductor materials. (J.R.D.)

10434 (EURAEC-55) WET PREPARATIONS OF UO_2 POWDERS. Quarterly Report No. 1. (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Mar. 31, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract [028-60-10RD1]. 70p.

Activities in a program to develop wet preparation methods for UO_2 are reported. The objective of this program is to obtain a product sinterable at 1400°C with impurity content of less than 1500 ppm as iron. Studies were conducted in the areas of tetravalent U precipitation in acid and basic solutions, drying processes, and sintering. A process for production of uranium hydroxide by precipitation from uranous chloride was developed. A drying method

was also developed; however results from presently used sintering methods are not satisfactory and further development of control methods is planned. Further examination and development are also planned for uranous hydroxide production, drying process and pilot-scale experiments. (J.R.D.)

10435 (NMI-2100) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report, October 1 through October 31, 1961. (Nuclear Metals, Inc., Concord, Mass.). Jan. 15, 1962. Contract AT(30-1)-2784. 15p.

Progress is reported on studies of high-temperature properties of refractory metal alloys, corrosion of zirconium alloys, irradiation behavior of metastable beta-phase uranium, and fundamentals of single crystal deformation in zone-refined beryllium. (B.O.G.)

10436 (Y-1361) PREPARATION AND HYDROGEN REDUCTION OF PURE, HIGH-SURFACE-AREA WO_3. F. Lambdin, Jr. and J. E. Perry (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Oct. 18, 1961. Contract W-7405-Eng-26. 45p.

Pilot-plant-scale equipment has been used in the development of a continuous process for the production of a pure, high-surface-area tungsten trioxide and its subsequent hydrogen reduction to high-surface-area tungsten metal powder. Ammonium paratungstate is utilized in the process as feed material. A controlled particle size precipitation of tungstic acid from the ammonium paratungstate solution with nitric acid in a jet-type precipitator is one of the techniques used in the method. The continuous hydrogen reduction of the tungsten trioxide is accomplished in a rotary kiln. The process produces tungsten trioxide in the surface area range of 10 to 62 square meters per gram (mean particle sizes of 0.084 to 0.013 microns), with an average total metallic and silicon impurity content of approximately 30 ppm and a carbon content of about 40 ppm. Hydrogen reduction of the oxide produces tungsten metal powder in the range of 3 to 7 square meters per gram (mean particle sizes of 0.10 to 0.044 microns), with an average total metallic and silicon impurity of approximately 100 ppm and an average carbon content of about 50 ppm. Other interstitial contaminants were found to vary with the surface area exhibited by the powder. Isostatically pressed pellets of the pure, high-surface-area powder showed densities of 93 to 95% of theoretical when sintered in dry hydrogen for three hours at 1500°C. (auth)

10437 (Y-1377) A DISSOLUTION STUDY OF HIGH-FIRED $BeO-UO_2$ CERAMICS BY FUSION. F. W. Postma, Jr. and R. E. Barringer (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Dec. 26, 1961. Contract W-7405-Eng-26. 12p.

A fusion method has been developed for the dissolution of high-fired $BeO-UO_2$ ceramic samples. Samples fused with a 7:1 Na_2O_2-to-sample ratio were completely soluble in dilute nitric acid. The fusion required one hour at 650°C. Iron crucibles were selected as the fusion containers. (auth)

10438 (AAEC/Trans-12) NUCLEAR APPLICATIONS FOR GRAPHITE IMPERMEABLE TO GASES AND LIQUIDS. E. Fitzer, O. Vohler, and K. W. Etzel. Translated by J. P. Chillag (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales) from Atomkernenergie, 6: 137-51(Apr. 1961). 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 19754.

10439 URANIUM FUSION FURNACES. Denis Rassak (Societe Generale d'Applications Electro-Thermiques, Paris). Inds. atomiques, 5: No. 9-10, 99-106(1961). (In French)

A review is given of the fusion furnace technology developed in France, Great Britain, and the United States. In spite of the differences in execution, the solutions adopted are supported by identical basic principles. After a review of the general characteristics of the fusion furnaces, various solutions are given. It is shown that the technology is now in the industrial stage. (tr-auth)

10440 APPLICATION TO THE MICROGRAPHIC STUDY OF NUCLEAR MATERIALS OF THE "PLUG" ELECTROLYTIC POLISHING. P. A. Jacquet and Maurice Bouleau (Centre d'Etudes Nucleaires, Saclay, France). Inds. atomiques, 5: No. 9-10, 113-123(1961). (In French)

The new technique of local electrolytic polishing (Ellopol) already used with great success for the majority of metallic surfaces is remarkably suitable for uranium, uranium alloys, zirconium and its alloys, thorium, and vanadium. In addition to the micrographs it gives, this technique presents substantial advantages over traditional electrolytic procedures (ease of operation and very low consumption of electrolyte whose composition does not change). Finally, it can be applied to samples of any shape and size, which is valuable for nondestructive control. When the surface can not be observed directly, a plastic replica method, which is not described, can be used. (tr-auth)

10441 CHOICE OF THE NITRIDING CONDITIONS AND OF THE DEPTH OF THE NITRIDE TREATED LAYER. A. A. Yurgenson. Metalloved. i Termichesk. Obrabotka Metal., No. 12, 13-16(Dec. 1961). (In Russian)

When steel is saturated with N, solid solutions of N in α- and γ-Fe are formed, and nitrides of the alloying elements are obtained after saturation is reached. The distorted lattice structure of nitrided steel treated at 520°C results in the improvement of the surface. X-ray diffraction studies indicate that the region under highest compression lies at a certain distance from the surface. If the surface layers contains about 50% ϵ-phase, the residual stresses may reach 20 kg/mm^2. The endurance limit of the nitrided steel reaches a maximum value at Δ/r = 0.1 to 0.2, where Δ designates the depth of the nitride and r indicates the distance from a neutral line to the area under highest stress. Care should be taken in design not to place the interface between the nitrided and untreated areas under strain. In certain steels nitriding causes an increase in the cavitation resistance of the alloy. The nitriding process is best carried out in an atmosphere containing a mixture of NH_3 and rare gases. As a general rule, the nitride layer should have a minimal depth, ensuring that all the alloying elements are present in form of their nitrides while the concentration of the Fe nitride is kept as low as possible. (TTT)

10442 HEAT TREATMENT OF SECTIONS MADE OF STEEL NO. G13L. Yu. A. Shul'te, M. I. Kurbatov, and S. I. Gladkiĭ (Zaporozhe Machine Construction Inst., [USSR]). Metalloved. i Termichesk. Obrabotka Metal., No. 12, 25-7(Dec. 1961). (In Russian)

The effect of heat treatment on the structure and the properties of Steel No. G13L was studied; this Hatfield-type steel contains 1.36% C, 12.74% Mn, and 0.58% Si. The heat treatment involved soaking the samples for 0.5, 1, and 2 hours at 900, 950, 1000, 1050, and 1100°C. Highest strength and plasticity were obtained when the samples were annealed at 1000 to 1050°C; the duration of the tests beyond about 30 minutes did not seem to affect the results. At lower annealing temperatures the residual carbides are

not completely dissolved while at higher temperatures grain growth takes place. Keeping the Mn content of the steel between 10.5 and 12.5% yielded a more stable material. Tempering with 15°C water resulted in further improvement of the mechanical properties of the steel. (TTT)

10443 HEAT TREATMENT OF WELDED STRUCTURES. M. Ya. Brovman, A. F. Mel'nikov, I. I. Tsomik, and B. M. Minukhin (Southern Ural Machine Plant, [USSR]). Metalloved. i Termichesk. Obrabotka Metal., No. 12, 28-9 (Dec. 1961). (In Russian)

Residual stresses near weldments reduce the strength of welded materials especially in case of varying loads. In order to relieve these stresses the metal next to the seam was heated by means of 2 torches to a temperature between 150 and 300°C while the seam itself was kept cold. By carefully choosing the velocity of the torches it was found possible to reduce the total time needed for relieving the residual stresses by a factor of about 25 to 30 with respect to heat treatment in a furnace, resulting in considerable savings in fabrication costs. The method lends itself easily to automation. (TTT)

10444 MEASUREMENT OF THE THERMAL CONTACT RESISTANCE BETWEEN LIQUID SODIUM AND STAINLESS STEEL. E. Jung (Technische Hochschule, Munich). Nukleonik, 3: 250-6(Nov. 1961). (In German)

A very accurate method for the measurement of the thermal contact resistance between stationary liquid sodium and stainless steel is given. Twenty-four contact surfaces were wired in series. It could be proven with certainty that the contact resistance of this pairing is smaller than 10^{-6} $m^2hgrd/kcal$. The method is principally applicable to other liquid/solid combinations. (tr-auth)

10445 THE SINTERING METHOD IN BORON CARBIDE, BORON NITRIDES AND METAL BORIDE ANALYSES. K. D. Modylevskaya, M. D. Lyutaya, and T. N. Nazarchuk (Inst. of Metal-Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Zavodskaya Lab., 27: 1345-52 (1961). (In Russian)

A method is suggested for preparing boron carbide, boron nitride, and metallic borides by sintering with CaO, MgO, and $BaCO_3$. The optimum sintering temperature is 900 to 1000°C for 1 to 2 hours; for chromium boride, 3 hours. The method does not require platinum crucibles. (tr-auth)

10446 SECOND INTERNATIONAL REINFORCED PLASTICS CONFERENCE, LONDON, 30 NOV.–2 DEC. 1960. London, The British Plastics Federation, [1961]. 391p.

Twenty-eight papers are included; a separate abstract was prepared for one. One paper was previously abstracted in NSA. The subjects presented and discussed are: production practice; recent advances in materials, processes, and designs; engineering in reinforced plastics; and uses. (N.W.R.)

10447 REINFORCED PLASTICS IN ATOMIC ENERGY INSTALLATIONS. I. D. Aitken and H. Wells (United Kingdom Atomic Energy Research Establishment, Harwell, Berks, Eng.). 20p. of "Second International Reinforced Plastics Conference, London, 30 Nov.–2 Dec. 1960." London, The British Plastics Federation, [1961].

A variety of applications where reinforced plastics have been used is discussed, and information on such factors as radiological contamination and the effects of ionizing radiations on reinforced plastics is given. The future trends in reinforced plastics, from an atomic energy viewpoint, are considered with respect to present limitations and development work in progress. (N.W.R.)

10448 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF CARBON. Hugh Wilson Davidson (to General Electric Co., Ltd.). British Patent 889,351. Feb. 14, 1962.

A process is outlined for producing carbon articles which are impermeable and stable at temperatures up to graphitizing temperatures. The process comprises the steps of dispersing in water hemicellulosic material, regenerating the material, shaping it to form an article, drying, heating to form carbon, and graphitizing the carbon at >2100°C. The hemicellulosic material is preferably xylan, and finely divided silica can be added to the dispersion to control the crystallinity of the final product. (D.L.C.)

10449 PROCESS FOR MANUFACTURING COMPACT OR FINE-PORED METALLIC COMPOSITIONS FROM PARTICULATE METALS. Charles Eyraud, Charles Daneyrolle, Maurice Chevreton, Germaine Thomas, Pierre Plurien, and Daniel Massignon (to Commissariat à l'Energie Atomique). British Patent 889,427. Feb. 14, 1962.

A process is outlined for manufacturing compact, fine-pored metal, metal–ceramic, or metal–synthetic resin compositions by agglomeration. The process has the advantages of using low temperatures and pressures and of being able to regulate the porosity of the compositions, and is suitable for making porous barriers for diffusing gases. The process comprises preparing a very fine metal powder by thermal decomposition of an organic acid salt of the metal and compressing the powder in a nonoxidizing atmosphere at a pressure >1 ton/cm^2 and a temperature preferably below that at which the thermal decomposition was carried out. The process is particularly applicable to the formates and oxalates of Ni, Co, Cu, and Ag and to mixtures of polytetrafluoroethylene with Ni and Cu. Twenty-five examples of the process are given. (D.L.C.)

Corrosion

10450 (AD-259882) A STUDY OF THE FUNDAMENTALS OF MASS TRANSFER BY LITHIUM: DEVELOPMENT OF APPARATUS. Final Report. M. F. Parkman (Stanford Research Inst., Menlo Park, Calif.). Jan. 1960. Contract 1 Nonr 2117(00). 39p.

The results of a 37-month study of the fundamentals of mass transfer by liquid lithium are reported. The first 20 months were concerned with the use of the toroid circulating apparatus, and the results were previously reported. It was concluded that the method was not satisfactory for producing the desired data; most of the time was spent in solving tangent problems in handling, purification, and analysis of lithium. The remainder of the effort was devoted principally to the design and construction of a new apparatus to study the fundamentals on a more direct basis. This apparatus is described. Two runs were completed, and from these the usefulness of the method is estimated. A comparison of the data with the proposed theoretical model is made to point out the problem areas that remain before a concrete confirmation of the theory can be attempted. Not enough runs were completed to demonstrate the validity of the theory. However, it is concluded that data which can be obtained with this method are likely to be limited in accuracy by the available physical property information, rather than by experimental error. (auth)

10451 (DC-60-6-125) EFFECT OF CHROMIZING ON THE OXIDATION AND SCALING RESISTANCE OF VARIOUS HIGH TEMPERATURE ALLOYS. S. E. Eckard (Gen-

eral Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 23, 1960. Contract AT(11-1)-171. 20p.

An investigation was conducted to determine the influence of surface chromizing on the oxidation resistance of several high temperature alloys. It was found that chromizing improves on the oxidation resistance of all alloys tested and it reduces surface alloy depletion of some alloys. (auth)

10452 (EURAEC-31) CORROSION OF NUCLEAR MATERIALS—LIST OF THE PRINCIPAL EUROPEAN PRODUCERS OF STAINLESS STEELS. (Brussels. Societe d'Etudes, de Recherches et d'Applications pour l'Industrie). Jan. 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract [007-60-3-RDB]. 56p. (B.S. 1033)

A list of European producers of stainless steel is presented. Included are tabular presentations of specifications on AISI 304, 316, 321, and 410 steels. (J.R.D.)

10453 (NAA-SR-6674) OXIDATION OF ZIRCONIUM AND ZIRCONIUM ALLOYS IN LIQUID SODIUM. T. L. MacKay (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 15, 1962. Contract AT(11-1)-Gen-8. 22p.

The oxidation of zirconium and several zirconium alloys was investigated in the temperature range of 400 to 635°C in a static liquid sodium system with oxygen concentration approximately 10 ppm. A transition from parabolic to linear rate of oxidation was observed in the temperature region 400 to 500°C for all of the zirconium alloys except Zircaloy-2. Above 500°C the transition was not observed and a protective film continued to form. Using the parabolic rate equation to describe the kinetics of oxidation, activation energies of 52.9 ± 0.5 kcal/mole for unalloyed Zr and 45.3 ± 1.5 kcal/mole for zirconium alloys were found. (auth)

10454 (NP-11312) PROTECTIVE COATINGS ON MAGNESIUM ALLOYS INTENDED FOR USE ON COMPONENTS OF AIRBORNE VEHICLES. Final Report (Detailed), June 1, 1960 to September 5, 1961. (Dow Metal Products Co. Technical Service and Development Lab., Midland, Mich.). Contract DA-20-018-ORD-19650. 51p.

Tin compound additions to polyvinyl butyral type clear primers provided very effective corrosion inhibition when applied to magnesium-steel galvanic couples. A combination of tributyltin oxide and finely divided metallic tin dust added to the clear primer offered the best protection by increasing the corrosion resistance 90% over non-inhibited primers. A major program evaluating the most promising finishing systems developed during this and previous contracts was initiated and involved 20% salt spray, rural and marine exterior exposures. Salt spray tests again showed the advantages of tin electroplated fasteners over cadmium plate when used in conjunction with Dow No. 17 Anodizing and various paint systems. The stannate coating gave results superior to Dow No. 17 and cadmium or phosphate coated steel fastener systems. After prolonged periods of exposure at minus 40°, electroplated tin on steel showed a slight transformation from Beta, white tin, to Alpha, gray tin, however, salt spray tests indicated no detrimental effects in corrosion resistance. Known methods of eliminating this phenomenon include additions of impurities such as 0.1% bismuth to the metal. Weatherometer tests of LA124 alloy magnesium panels that were part of the finishing studies for the M113 hull were completed. After 650 hours exposure, the corrosion characteristics of painted and unpainted panels, with and without steel fasteners comparing Dow No. 17 anodizing and the stannate coating were very encouraging. Similar panels exposed to rural exterior atmospheres for 15 months showed the same good results with very little or no galvanic corrosion. Good paint adhesion characteristics of the stannate coating were also shown. Electrical resistivity measurements to determine the conductivity of the stannate coating showed only 8.0 microhms per square inch as compared to 7.0 microhms for bare magnesium and a high of 74,000 microhms for Dow No. 17 thin anodize. The development, improvement, and finalization of the stannate process involved considerable effort during this contract period. Several factors relating to known or expected problems such as chromate poisoning of the bath, powdery coatings, failure of steel components to coat, and pretreatment methods were explored. Steady improvements of the stannate application process were achieved and tentative processing bulletins were revised to include the new developments as they were proven. The most recent bulletin includes the best known procedures for applying the stannate coating. The operational limits of the bath, methods of analysis, a few operational difficulties that may arise, and sources of supply of chemicals are discussed. (auth)

10455 (ORNL-3253) CORROSION OF VOLATILITY PILOT PLANT MARK I INOR-8 HYDROFLUORINATOR AND MARK III L NICKEL FLUORINATOR AFTER FOURTEEN DISSOLUTION RUNS. A. P. Litman (Oak Ridge National Lab., Tenn.). Feb. 26, 1962. Contract W-7405-Eng-26. 32p.

Process corrosion occurring in the current Volatility Pilot Plant hydrofluorinator and fluorinator in operation at the Oak Ridge National Laboratory was evaluated by visual inspections, chemical analyses, transport studies of Ni, Mo, Cr, and Fe, gamma radiography, wax replication, ultrasonic thickness measurements, and metallographic studies. The modes, mechanisms, and rates of corrosive attack seem to agree well with previous experimental work. Significant bulk metal losses and moderate pitting attack were noted in both vessels. Maximum attack in the hydrofluorinator, which operated from 650 to 500°C, occurred in the middle vapor region at a calculated corrosion rate of 20 mils/month, based on 765 hr of molten fluoride salt residence time, and 0.06 mil/hr, based on 338.5 hr of hydrogen fluoride exposure time. The fluorinator, which operated at about 500°C, sustained maximum bulk metal losses in the lower vapor region at calculated rates of 28 mils/month, based on 694 hr of salt residence time, and 0.9 mil/hr, based on 30.9 hr of fluorine exposure time. Calculations based on losses in wall thickness indicate that both vessels should be capable of handling approximately 100 additional dissolution runs. These calculations include pitting corrosion in the hydrofluorinator but ignore effects resulting from intergranular or other forms of selective attack which may be present in both vessels. (auth)

10456 (TID-14956) AN INVESTIGATION OF THE EFFECT OF METALLIC ADDITIONS UPON THE OXIDATION RESISTANCE OF $NbAl_3$. Monthly Letter Report No. 5, January 1, 1962 to February 1, 1962. Donald T. Klodt, Ronald L. Wells, and Charles E. Lundin (Denver. Univ. Denver Research Inst.). Feb. 8, 1962. Contract AT(11-1)-1092. 3p.

Phase equilibria and oxidation survey studies were continued on $NbAl_3$ compound alloys with the following ternary metallic additions: V, T, Sn, and Si. Preliminary oxidation tests on the ternary alloys revealed relatively small rates of attack, and the oxide formed was apparently protective in nature. (M.C.G.)

10457 (TID-14977) TECHNICAL PROGRESS REPORT [ON PHOTOVOLTAIC EFFECTS OCCURRING WITH ANODIZED ZIRCONIUM AND NIOBIUM ELECTRODES]. (Temple Univ., Philadelphia). Feb. 1961. Contract AT(30-1)-2775. 20p.

Activities in an investigation of the photovoltaic effects occurring with anodized Zr and Nb electrodes are reported. Photovoltaic decay curves for these electrodes were obtained. A theory was also developed to interpret the form of the curves. The theory appears to explain the results obtained with Zr, however some doubt may arise in connection with the conclusion concerning a large partial electronic temperature compared with the lattice temperature. (J.R.D.)

10458 (AEC-tr-5003) ELECTROCHEMICAL KINETICS OF CORROSION PROCESSES UNDER ADSORBED FILMS OF MOISTURE. N. D. Tomashov and Yu. N. Mikhailovskii. Translated by Lydia Venters (Argonne National Lab., Ill.) from Trudy 4-go(Chetvertogo) Soveshchaniya Elektrokhim., Moscow, 1956, p.638-45(Pub. 1959). 10p.

An investigation was made of the electrochemical behavior of a series of metals under the adsorption films of moisture. The shares of the cathode, anode, and ohmic control in the operation of the corrosion element in an atmosphere with humidity up to 100% was determined quantitatively. Cu, Zn, Fe, and Al foils were used as research electrodes. The potentials of all metals, investigated during the process of their maintenance in a humid atmosphere, improved. Anode polarization capacity of the metals increased substantially when the humidity of the air decreased. When the humidity of the air decreased the cathode polarization also increased. Graphs are included. (M.C.G.)

10459 (NSF-62-35(2)) INVESTIGATION OF THE STRESS CORROSION OF STEEL IN REGARD TO THE OPERATION OF THE STEAM GENERATORS OF ATOMIC POWER PLANTS. A translation of "Izuchenie Korrozii pod Napryazheniem Stalei Primenitel'no k Rabote Parogeneratorov Atomnykh Elektrostantsii." P. A. Akol'zin and L. V. Korneeva (U.S.S.R. Sovet Ministrov. Glavnoe Upravlenie po Ispol'zovaniyu Atomnoi Energii, Moscow). 1960. 21p.

Results are presented of investigations of the salt composition and heat treatment in the development of stress corrosion of various types of steels, including welded specimens. It was found that the cracking of austenitic stainless steels because of stress corrosion takes place in water containing chlorine ions and molecular oxygen. The intensity of the stress corrosion increased with increasing temperature. In media with a higher content of chlorine ions the welded samples were more sensitive to stress corrosion. The results obtained in these corrosion studies are discussed in regard to the operation of steam generators in atomic power plants. (M.C.G.)

10460 PROBLEMS OF CORROSION AND PURIFICATION IN WATER-COOLED REACTORS. G. Pier (Forschungsinstitut der Mannesmann A. G., Krefeld, Ger.). Atomwirtschaft, 6: 601-4(Dec. 1961). (in German)

Long-term research into the general corrosion resistance of materials for water-cooled reactors and experiments on the susceptibility to stress and pitting corrosion of tubes and sheets of high-alloy chromium and chromium–nickel steels in pure water at 70°C indicated neither a general erosive attack nor the occurrence of either stress or pitting corrosion. A process specifically developed for the final cleaning of reactors and materials is described. (auth)

10461 CORROSION STUDIES. XXIV. EFFECT OF TEMPERATURE ON THE PASSIVATION CHARACTERISTIC OF CORROSION-RESISTANT STEEL. M. Pražák and J. Spanilý (Staatliches Forschungsinstitut für Materialschutz, Prague). Collection Czechoslov. Chem. Communs., 26: 2828-37(Nov. 1961). (In German)

The temperature dependence of the corrosion reactions of two typical corrosion resistant chromium–nickel steels was determined in regions of critical passivation current, passivity, transpassivity, and secondary passivity. The dependencies were quantitatively determined from the Arrhenius equation. On the basis of the value of the activation energies of the reactions occurring, definite representations of the mechanisms of the relevant processes were constructed. From the results it was shown that corrosion in the passive state increases very rapidly with increasing temperature (in the range 20 to 210°C with the ratio $1:10^7$), so that it can be of engineering significance at higher temperatures. The stability of the passive state and the passivation tendencies of the material decrease simultaneously with increasing temperature. It was established that accordingly the efficiency of a corrosion inhibition decreases by means of passifying inhibitors. (tr-auth)

10462 MASS TRANSFER OF TYPE 316 STAINLESS STEEL BY LIQUID LITHIUM. H. W. Leavenworth and D. P. Gregory (Pratt and Whitney Aircraft, Middletown, Conn.). Corrosion, 18: 43t-4t(Feb. 1962).

Results of a study of mass transfer corrosion of Type 316 stainless steel by liquid lithium in the temperature range of 1100-1600°F are shown. Metallographic results showed four different types of hot zone attack. The first attack of transgranular nature occurred in a temperature range of 1100-1400°F. Remaining mass corrosion occurred in a higher temperature range of 1400-1600°F. (auth)

10463 EFFECT OF FIVE IMPURITIES ON THE HIGH TEMPERATURE WATER AND STEAM CORROSION RESISTANCE OF ZIRCALOY-2. L. S. Rubenstein (Carnegie Inst. of Tech., Pittsburgh), J. G. Goodwin, and F. L. Shubert. Corrosion, 18: 45t-54t(Feb. 1962). (WAPD-T-923)

Five impurities (Al, Mn, N, Cu, and Si), each at two concentrations, were studied in relation to the effect they had on the high temperature water and steam corrosion of Zircaloy-2. Sixteen ingots were fabricated to strip, and 36 specimens were taken from each ingot for corrosion testing. To investigate the heat treatment-impurity element interaction, three heat treatment conditions were incorporated in the experimental design. The average of all the furnace-cooled coupons had a somewhat lower corrosion rate than the average air-cooled or as-received coupons, but the initial weight gains were higher. Results showed that aluminum is detrimental to the 750°F steam test and 680°F water corrosion resistance of Zircaloy-2. Silicon at certain levels is beneficial in normalizing the corrosion weight gain of material furnace cooled. Manganese slightly increases the corrosion rate in 750°F steam and 680°F water, but is not considered significantly detrimental in the concentration ranges normally encountered. Copper shows no effect on the corrosion resistance. Nitrogen in the ranges studied did not affect the corrosion rate but did increase the total weight gains. (auth)

10464 TESTING OF COLUMBIUM AND COLUMBIUM ALLOYS. Donald L. Macleary (E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.). Corrosion, 18: 67t-9t (Feb. 1962).

Results of laboratory testing of columbium and columbium alloys as corrosion resistant materials are sum-

marized. Columbium, having the lowest density of the refractory metals group, has higher thermal conductivity than Zircaloy-2 or austenitic stainless steel. In chemical corrosion tests the Nb–10Ti–10Mo alloy was found to be much less resistant than unalloyed columbium. Oxidation resistance of columbium was improved by alloying for flowing air exposures at 2000 and 2200°F for times up to 100 hours. The alloy Nb–1Zr was completely resistant to the various liquid metals except for welds that suffered intergranular corrosion. The Nb–7V alloy seemed to be more practical than the Nb–10Ti–10Mo alloy on the basis of weldability and good high temperature strength properties. (auth)

10465 FISSION FRAGMENT RECOIL EFFECTS ON ZIRCONIUM OXIDATION. W. C. Yee and G. H. Jenks (Oak Ridge National Lab., Tenn.). J. Electrochem. Soc., 109: 198-204(Mar. 1962).

Fission fragment recoil effects on zirconium oxidation in pure oxygen were studied at 1 atm pressure and 250°C. Specimens were oxidized under the following conditions: reactor radiations including recoils, reactor radiations in the absence of recoils, and no radiation. Irradiation experiments were conducted in a maximum thermal neutron flux of 8.5×10^{11} neutrons/cm^2-sec. Specimen surfaces subject to fission fragments were exposed to an estimated average recoil intensity of 6×10^8 particles/cm^2-sec, the average particle energy being about 32 Mev or ~40% of the initial energy. It was concluded from electron and optical microscopy studies of the specimens that the normal oxide film on surfaces exposed to recoils underwent a phase transformation with fine particle size, although the possibility that the normal oxide developed a fine particle size of random orientation was not ruled out. From estimates of oxide thickness based on interference colors and from a limited amount of weight gain data, it was concluded that the oxide film on surfaces exposed to fission fragments was thicker than surfaces exposed to reactor radiation alone. The amount of corrosion as indicated by the oxide thickness and weight data was at least a factor of ten less than that expected in a solution of uranyl sulfate producing an equivalent recoil intensity. However, the data obtained do not provide sufficient information to establish the mechanism of the effects of fission fragment recoils on zirconium oxidation. (auth)

10466 OXIDATION OF ZIRCONIUM AND ZIRCONIUM–OXYGEN ALLOYS AT 800°C. K. Oesthagen and P. Kofstad (Central Inst. for Industrial Research, Oslo). J. Electrochem. Soc., 109: 204-7(Mar. 1962).

Oxidation of zirconium and zirconium–oxygen alloys in oxygen at 800°C was studied. The studies include gravimetric oxidation rate measurements and metallographic and x-ray diffraction studies of oxidized specimens. The initial oxidation conforms with an approximate cubic oxidation rate, after which a breakaway oxidation is observed. The initial cubic period becomes shorter and the rate of breakaway oxidation becomes faster with increasing oxygen concentration up to 12-15 at. % oxygen. The oxidation is interpreted in terms of simultaneous oxide formation and oxygen dissolution in the metal. (auth)

10467 INTERNAL OXIDATION IN IRON–CHROMIUM–YTTRIUM ALLOYS. Edward J. Felten (Pratt and Whitney Aircraft, North Haven, Conn.). Trans. Met. Soc. AIME, 224: 202-3(Feb. 1962).

Specimens of Fe–25Cr–1Y alloy were heated in the form of layers in a stream of flowing oxygen for varying periods of time at 1000, 1100, and 1200°C. Data obtained in the experiments show good agreement with the parabolic rate law indicating a diffusion controlled process. Photomicrographs show that the internal oxide formed during oxidation of Fe–Cr–Y alloys is concentrated at the grain boundaries. The disappearance of the second phase in the region where the internal oxide was found tends to substantiate the hypothesis that this type of oxide is due to the simultaneous movement of anions and cations during oxidation. The formation of internal oxide in Fe–Cr–Y alloys is diffusion controlled. The oxide is found concentrated at the grain boundaries and to be composed of Y_2O_3 or $YCrO_3$ depending on the oxidation temperature. (P.C.H.)

10468 STRESS-CORROSION TESTING OF AlZnMg$_3$ UNDER CONSTANT TENSILE AND BEND STRESS. Paul Brenner and Wolfgang Gruhl (Vereinigte Leichtmetall-Werke G.m.b.H., Bonn). Z. Metallk., 52: 599-607(Oct. 1961). (In German)

The stress corrosion behavior of Al–Zn–Mg$_3$ was studied after aging at 90°C for 140 hours in a newly developed apparatus under uniformly distributed tensile and bending stress. It was found that the logarithm of the durability depends linearly on the implied stress and satisfies the relation $Z = K e^{c*\sigma}$. The constants c and K for tensile and bending stress were determined. It was observed that bending stresses are less dangerous than tensile stresses. The durability of the specimens became unlimited below 12 kp/mm^2 because of the break in the σ-L curve. The life after a plastic deformation of the age-hardened state was decreased by high stresses and increased by low stresses. At the same time the stress-dependent constant c increased while the constant K decreased. This effect was more evident at bending stresses than at tensile stresses. The spontaneous occurrence of intergranular stress-corrosion cracks stopped immediately after reaching a certain elongation. This phenomena was studied by automatically recording the bending values as a function of time during a corrosion under bending stress. The results are discussed and conclusions are drawn which should guide future testing methods. (auth)

Fabrication

10469 (ASD-TR-7-532a(V)) MACHINING OF REFRACTORY MATERIALS. PHASE II. Technical Engineering Report, November 1, 1961 to January 31, 1962. L. J. Nowikowski, N. Zlatin, and M. Field (Metcut Research Associates Inc., Cincinnati). Feb. 1962. Contract AF 33(600)-42349. 152p.

Machining studies were performed on pressed and sintered unalloyed W, 90Ta-10W alloy, molybdenum TZM and Mo-0.5% Ti alloys, and D6AC steel quenched and tempered to 56 and 58 R_c. The investigation consisted of drilling tests on W; face milling, end milling, drilling and grinding on 90Ta-10W alloy; turning and end milling on Mo alloys; and turning, face milling, slotting, end milling, reaming, grinding, distortion studies and residual stress analyses on D6AC steel. (auth)

10470 (ASD-TR-7-784(VI)) THE DEVELOPMENT OF OPTIMUM MANUFACTURING METHODS FOR COLUMBIUM ALLOY SHEET. Interim Technical Engineering Report, July 31, 1961–December 31, 1961. J. B. Guernsey and A. E. Leach (Crucible Steel Co. of America. Midland Research Lab., Penna.). Contract AF33(600)-39942. 48p.

Two 8-inch D31 ingots were found to be uniform in structure and chemical composition both within an ingot and between ingots, with the exception of variable Ti content. Sheet processed from various locations in the two ingots is very uniform in properties at 0 to 2200°F. D31 was found

to be readily forgeable with relatively simple techniques. Laboratory programs to determine optimum processing sequences for both F48 and D31 are near completion. (auth)

10471 (BMI-1567) A THEORETICAL STUDY OF THE ROTARY SIZING OF URANIUM TUBE. Edward G. Bodine, Edward G. Smith, and Stan J. Paprocki (Battelle Memorial Inst., Columbus, Ohio). Feb. 15, 1962. Contract W-7405-Eng-92. 24p.

Although the principles of the theory of plasticity are evoked, an engineering approach is used to examine some of the probable variables during the rotary sizing of U tube in an Assel mill. It is recognized at the onset that an exact solution based entirely on the mathematical theory of plasticity is, at present, neither warranted nor possible in view of the complexity of the deformation process and the idiosyncrasies in the behavior of U. A simplification of the problem is, therefore, made and an evaluation of the assumptions is qualitatively given. The results indicate that the process will produce good-quality tube with a radially deformed structure and some spirally oriented grains—especially at the outside of the tube. The loads and horsepower requirements are within the range of the available equipment. The heatup of the U due to work will be approximately 100°F at the highest proposed mill setting. (auth)

10472 (DC-55-5-16) DEVELOPMENT OF RESISTANCE WELDING TECHNIQUE FOR THERMOCOUPLE ATTACHMENT. R. R. Cost (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 25, 1955. Contract AT(11-1)-171. 12p.

An investigation was undertaken to develop a method for attaching Pt-Pt-10Rh thermocouples by resistance welding to thin 80 Ni—20 Cr clad fuel sheet and produce metallurgically sound joints or nuggets. Data and microstructures are shown to illustrate that the a-c type resistance welder is capable of producing metallurgically sound welds consistently and without surface damage to the fuel sheet. Recommended welding techniques for producing metallurgically sound resistance welds are given. (auth)

10473 (DC 57-3-164) FABRICATION PROCEDURES FOR HYDRIDED ZIRCONIUM SOLID MODERATOR SECTIONS. C. O. Tarr (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 13, 1957. Contract AT(11-1)-171. 36p.

The fabrication procedures for the Project 101 solid moderator section of hydrided zirconium clad with molybdenum and stainless steel are presented. (auth)

10474 (DC-57-4-25) ANALYTICAL STUDY OF HEX SHAPE FABRICATION. Virgil H. Lucke (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 29, 1957. Contract AT(11-1)-171. 19p.

Information obtained from an analytical study of the fabrication of the composite hex shape is presented. Nominal die size data for Projects 101 and 102 and a description of the calculation method are included. The effects of tolerances on dies and component parts, and variations in the diameter of the tube roller were analyzed using statistical methods. Two proposed methods of bonding and their known inherent difficulties and limitations are summarized. The thermal stresses induced in the composite hex. shape and the coefficient of thermal expansion of the composite are also calculated. (auth)

10475 (DC-57-6-87) INDUCTION BRAZING OF FUEL ELEMENTS. R. C. Moreland (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 13, 1957. Contract AT(11-1)-171. 13p.

An investigation was undertaken to determine the feasibility of induction heating as a method of edge-seal brazing of clad Nb fuel ribbon. Photographs and photomicrographs are presented which show that induction-brazed edge seals are, in general, of poor quality. Difficulties encountered are poor braze flow and severe cracking in the edge seal braze joint. It is concluded that induction heating is not adaptable to edge seal brazing of Nb fuel ribbon. (auth)

10476 (DC-60-2-212) CAMBER STUDY OF EXTRUDED TUBES. C. L. Brown and T. A. Mroz (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 22, 1960. Contract AT(11-1)-171. 30p.

Camber data on BeO white tubes taken at different steps in the process were analyzed to determine relationships between camber after green-cut, after pre-fire, and after hi-fire and the effects on tube camber of batch and position in the hi-fire boat. It was found that the final camber of a tube was produced mainly in the hi-fire operation and not in pre-fire or green cutting. Significant differences existed between the batches, probably caused by inconsistencies in the mixing or extruding operation. The position of a tube in the hi-fire boat had no effect on its final camber. (auth)

10477 (EURAEC-14) URANIUM OXIDE EXTRUSION. Quarterly Report No. 3. (Compagnie Industrielle des Combustibles Atomiques Frittes, Corbeville, par Orsay (Seine-et-Oise), France). June 15, 1960. Work performed under United States-Euratom Joint Research and Development Program. Contract [001-59-9-RDF]. 22p.

Fabrication studies are described in which cylindrical uranium oxide rods were produced by rectification with a diamond grinding wheel. The rods were obtained by rhodoviol extrusion of uranium oxide with average surface of 7 to 8 m^2/g. Rod sintering tests confirmed earlier evidence that special conditions are necessary to obtain rods with a deflection under 1 mm without rectification. Rectification is possible with a diamond grinding wheel on rods with 3 mm deflection. The effects of specific surface on final density were shown thus confirming the necessity for eliminating small surfaces in favor of medium and perhaps large surfaces for oxide extrusion. A comparative study of uranium oxides from various sources was initiated. (J.R.D.)

10478 (EURAEC-15) URANIUM OXIDE EXTRUSION. Quarterly Report No. 4. (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine-et-Oise), France). Sept. 15, 1960. Work performed under United States-Euratom Joint Research and Development Program. Contract [001-59-9-RDF]. 15p.

Extrusion of about 50 uranium oxide rods with specific surfaces between 3 and 8 m^2/g is reported. The rods were extruded using rhodoviol plasticizers and sintered at 1600 to 1630°C. Extrusion tests of American, Belgian, and Canadian powders were completed. Reproducibility in the tests was fairly good but density of the sintered rods was in all cases below that desired. Further study of method to increase rod density is planned. (J.R.D.)

10479 (EURAEC-16) URANIUM OXIDE EXTRUSION. Final Report. R. Hauser and J. Mercier (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine-et-Oise), France). Jan. 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract 001-59-9-RDF. 29p.

Studies were made of the influences of extrusion, preparation of pastes, sintering, and rectification before and after sintering on uranium oxide for obtaining cylindrical, revolution rods 14- to 15-mm diameter, 180- to 260-mm long, and 10- to 10.25-g/cm^3 density, with rectified di-

mensional tolerances of ±0.05 mm of the diameter and iron equivalent impurities <1500 ppm. The studies led to checking raw materials to measure specific surfaces and O/U ratio. Measurements were made of the bending-strength breaking loads of the extruded rods. Using the semi-bulk method of sintering, followed by rectification, it is shown that the process of shaping by extrusion may be rendered industrial. (auth)

10480 (GA-2691) A PROGRAM OF RESEARCH ON MECHANICAL METALLURGY AS RELATED TO FUEL-ELEMENT FABRICATION. Summary Report, January 1–September 30, 1961. T. A. Trozera, J. L. White, and R. H. Chambers (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 20, 1961. Contract AT(04-3)-167. 35p.

Research progress on mechanical metallurgy of reactor materials is reported in three sections: deformation characteristics of reactor materials, stored energy of cold work, and microplastic properties and mechanical relaxation spectra of very pure refractory bcc metals. (M.C.G.)

10481 (GEAP-3775) FABRICATION OF FUEL RODS BY TANDEM ROLLING. J. W. Lingafelter (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). July 1961. Contract AT(04-3)-361. 69p.

The tandem rolling process used industrially to manufacture tubular resistance heating elements was investigated to determine its applicability for fabricating rod-type fuel elements. Approximately 90 stainless steel clad fuel rods containing natural UO_2 were tandem-rolled to establish optimum rolling parameters and fuel rod design. Fuel rod diameter, cladding wall thickness, UO_2 particle size, rolling speed, and rolling reduction were investigated to determine their effect on UO_2 compacted density, fuel rod clad integrity, and fuel rod quality. From this work, optimum rolling conditions were selected, and 26 fuel rods containing 3.5% enriched UO_2 clad in 0.015-in. stainless steel were rolled for the purpose of producing fuel rods for irradiation testing. The enriched fuel rods were successfully rolled to an average UO_2 density of 89%, a final diameter of 0.400 inch, and a length of 38 inches. Twenty-one of the enriched fuel rods were assembled into a 25-rod fuel assembly and inserted into the Vallecitos Boiling Water Reactor core during June, 1961. The tandem-rolling process was successfully adapted to fabricate stainless steel clad, UO_2-filled fuel rods. The process can produce 90% dense quality fuel rods on a production basis with essentially no change from the way it is used for commercial applications. A fuel rod as-rolled capacity of 350,000 feet per month per machine was demonstrated. (auth)

10482 (NP-11347) PREPARATION OF ALUMINUM ALLOY SHOT. W. A. Pollard (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Mar. 2, 1960. 5p. (PM-I-60-8)

A method was developed for preparing Al–13% U alloy in the form of shot. The method comprises forcing the molten (700°C) alloy through holes in a crucible and thence into water at 65°C to form the shot. (D.L.C.)

10483 (NYO-9586) APPLICATIONS OF ULTRASONIC ENERGY. ULTRASONIC CASTING OF CERAMIC AND CERMET SLIPS. C. Dana McKinney, Jr., William B. Tarpley, and Frederick H. Gaskins (Aeroprojects, Inc., West Chester, Penna.). Nov. 1961. Contract AT(30-1)-1836. 47p.

An investigation of the application of ultrasonic energy to slip casting processes demonstrated several beneficial effects. Ultrasonic activation of plaster molds resulted in increased green strength which made the specimens easier to handle and less subject to distortion, and increased green density (as much as 25%), which resulted in reduced firing shrinkage. Ultrasonic flow promotion permitted casting of slips of high solids content which could not normally be used. Plate-like cross sections, 0.06-in. thick by 24-in. deep, were successfully filled. It was demonstrated that cermet compositions, containing materials of different density and particle-size distributions, do not undergo preferential settling of dense materials during ultrasonic casting. After filling the mold, continued activation led to a 50% improvement in dewatering of the cast specimen. Studies of the mechanism by which slip casting is improved indicated that significant ultrasonic intensity levels are achieved in the various slip compositions. Ultrasonic activation greatly reduced the apparent viscosity of these thixotropic slips, accomplished rapid gas removal from the wetted walls, promoted uniformity in mixed density compositions, and increased the rate of flow of water through the ceramic. (auth)

10484 (NYO-10007) ULTRASONIC HOT PRESSING OF METALS AND CERAMICS. William B. Tarpley and Herbert Kartluke (Aeroprojects, Inc., West Chester, Penna.). Dec. 1961. Contract AT(30-1)-1836. 26p.

The feasibility of ultrasonic hot pressing was demonstrated on silver, calcium fluoride, and aluminum oxide powders. A hermetically-sealable, force-insensitive acoustic mounting system was used to penetrate into the high-pressure (up to 5000 psi) and high-temperature (up to 2550°F) controlled atmosphere environment. The density of silver powder compacts was increased as much as 1.6 times that of the nonultrasonic controls. Reductions in the temperature or in the pressure necessary to achieve comparable density were observed with ultrasonic activation under otherwise constant conditions. Similar results were obtained with calcium fluoride; the densities of ultrasonically activated specimens were comparable to controls requiring 200 to 300°F higher temperatures. Submicron aluminum oxide powder was ultrasonically hot pressed with graphite tooling. A 13% improvement in density was achieved as a result of ultrasonic activation under isothermal conditions at the normal 4-hr pressing time. With 2-hr ultrasonic pressing, at temperatures 250°F lower than the 4-hr controls, it was also possible to produce equivalent density. With further evolution of the hot-pressing array, increased-magnitude effects may be expected. A number of undesirable side effects of high-temperature hot pressing may be avoided through ultrasonic activation. (auth)

10485 (SEP-259) FUNDAMENTALS OF SINTERING-VI. Sixth Annual Progress Report, July 1, 1960–June 30, 1961. J. Brett and L. Seigle (General Telephone and Electronics Labs. Inc., Bayside, N. Y.). Dec. 15, 1961. Contract AT(30-1)-2102. 27p. (TR-61-101.6)

In an effort to establish the proportion of vacancies transmitted to the surface along grain boundaries during sintering, an interferrometric study of grain boundary grooves in the neck of twisted three-wire copper compacts was carried out. Longitudinal boundaries migrated in the neck during sintering, giving rise to undulations on the neck surface. Transverse boundaries in the neck showed little, if any, enhancement of grooving compared to their extensions away from the neck. There was no indication in the shape or rate of formation of grain boundary grooves that substantial diffusion of vacancies along grain boundaries to the surface occurs. It was concluded that vacancies are eliminated during sintering primarily by annihilation in the grain boundary. (auth)

10486 (TID-14971) WELDING OR JOINING OF EXOTIC METALS. [Jay Bland (Knolls Atomic Power Lab., Schenectady, N. Y.) Feb. 21, 1962. Contract W-31-109-Eng-52]. 11p.

Presented orally at American Welding Society, Toledo Section, Feb. 21, 1962.

A summary is presented of the talk on the welding of niobium, beryllium, uranium, Zircaloy-2, titanium, molybdenum, Inconel, Monel, stainless steel, copper, aluminum, carbon steel, and hafnium. Slides presented at the talk are included. (B.O.G.)

10487 (XDCL-58-7-23) FABRICATION OF HIGH TEMPERATURE MODERATORS; INVENTION DISCLOSURE. William S. Chenault (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 11, 1958. Contract AT(11-1)-171. 8p.

A process proposed for patent involving laminated construction of high temperature moderator parts from Zr or Y hydrides is described. Possible fabrication variations are described along with the presently used ANP method. Reasons for increased design versatility by use of the new method are listed. (J.R.D.)

10488 (FTD-TT-62-251) PROBLEMS OF WELDING TITIANIUM AND OTHER CHEMICALLY ACTIVE METALS. S. M. Gurevich. Translated from p.1-15 of "Fragen des Schweissens von Titan und Anderer Chemisch Aktiver Metalle." Presented at the 2nd International Colloquium on Weldability and Welding Metallurgy Held at Weimar, Germany, March 2-3, 1961. 14p.

Problems that arise in the automatic welding of Ti and its alloys and the electron-beam welding of chemically active metals are discussed. The welding of Ti and its alloys involves possible formation of coarse grains and cracks. (D.L.C.)

10489 (NP-tr-821) THE ACTION OF LUBRICANTS IN PRESSURE WORKING OF METALS. S. Ya. Veyler and V. I. Likhtman. Translation of p.1-231 of "Deystviye Smazok pri Obrabotke Metallov Daveleniyem." (A publication of the Publishing House of the Academy of Sciences, Moscow, 1960. 362p.

Data on lubricating compounds for use in metal pressworking are presented. In other sections, new concepts of the lubrication mechanism are developed and used to describe the processes of wire-drawing, deep-drawing, and metal extrusion. The concepts are also used as a basis for selection of lubricants for a number of metals-pressworking processes. (J.R.D.)

10490 MANUFACTURE OF THE FUEL FOR RAPSODIE. The Point Reached in Studies and Manufacturing Equipment. Bull. inform. sci. et tech. (Paris), No. 57, 39-50 (Dec. 1961). (In French)

Studies on the ternary alloy are now complete. Problems raised by cladding (sodium bond, intermediate niobium sheath) were satisfactorily solved. The first results of irradiation tests indicate an appreciable swelling and experiments are being made to determine the effect of the sheath on this effect. Tests on the irradiation of whole fuel pins in EL3 with thermal neutrons were made, and will be undertaken in BR-2 with fast neutrons. Experiments on full-scale and enlarged models have led to the determination of the hydraulic characteristics of the sodium flow around the pins in the fuel element. Finally an account is given of the fuel element workshop to be built at Cadarache. (auth)

10491 FABRICATING FUEL ELEMENTS FOR A GAS-COOLED NUCLEAR REACTOR. C. W. Funk (Aerojet-General Nucleonics, San Ramon, Calif.) and T. L. Gregory. Metal. Progr., 81: No. 3, 78-82; 120; 122 (Mar. 1962).

Fuel elements for the GCRE-I reactor are made by forming flat plates—30% UO_2-stainless steel dispersion clad with stainless steel—into circular segments. These curved fuel plates are then joined into a concentric ring assembly by means of mechanical clips. (auth)

10492 PERMANENT ELECTRODES FOR MAGNETO-HYDRODYNAMIC POWER GENERATION. J. Maycock, J. A. Noé, and D. T. Swift-Hook (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). Nature, 193: 467-8 (Feb. 3, 1962).

Some preliminary results which suggest a possible way in which permanent electrodes may be obtained are given. The permanent electrode system consists of depositing carbon from a gas stream on water-cooled metal surfaces. As this carbon layer is ablated away more carbon may be deposited to maintain an equilibrium thickness, so that the electrode surface is continuously replaced. The carbon surface in contact with the ionized gas will be hot enough to emit freely so that there should be no drop in voltage at the electrodes, and the heat transfer should be considerably less than that to a bare cold metal surface. (N.W.R.)

10493 PRODUCTION OF SUPERCONDUCTING NIOBIUM FILMS BY VACUUM-ARC DEPOSITION. M. S. P. Lucas and D. T. Meyer (Duke Univ., Durham, N. C.). Nature, 193: 766-7 (Feb. 24, 1962).

By the use of a vacuum-arc deposition technique, superconducting niobium films of nonuniform thickness were produced with transition temperatures greater than 4.2°K. The deposition was carried out in vacua of 5 to 8×10^{-6} torr and at a separation distance of 3 mm between the glass substrate and the arc electrodes. (D.L.C.)

10494 FABRICATING THIN NEUTRON FOILS. Norman A. Frigerio (Argonne National Lab., Ill.). Nucleonics, 20: No. 3, 78 (Mar. 1962).

Methods for fabricating thin neutron foil dispersions of readily available salts, complexes, and covalent compounds in inert matrices for trace-element activation analysis are discussed. The foils are inexpensive, easy to handle, chemically stable, and easy to fabricate by mechanical methods. The properties of nine matrix materials for neutron foils are given along with the nuclide concentrations of 15 compounds for integrated fluxes of 10^{12} n/cm^2. The matrices are fabricated by impregnating with solutions of the nuclide to be activated, drying, ball milling, pressing, and forming. (N.W.R.)

10495 SINTERING OF BERYLLIUM OXIDE. P. P. Budnikov and A. A. Zvyagil'skii. Ogneupory, 26: No. 11, 525-30 (1961).

A study of the variation with temperature of BeO properties (shrinkage, water-holding capacity, volume weight, porosity, dynamics of weight losses, refractive index, crystal size, specific weight, and chemical resistance) was made to determine the optimum conditions for the manufacture of dense ceramic objects from the compound. The following factors are recommended: prefiring beryllium hydroxide in the range 1350 to 1500°C; use of BeO of maximum specific weight; preliminary grinding of prefired BeO to an average particle size of less than 2 to 3 μ; use of molding material of which 20 to 30% is in the form of a hydroxide or low-temperature calcined oxide; use of plasticizers such as paraffin wax, 7.5% starch solution, or 5% solution of $BeCl_2$ to insure homogeneity of mass; application of high specific molding pressure; and prolonged exposure at final firing temperature for recrystallization. (OTS)

10496 THE MECHANICAL AND BONDING PROCESSES IN THE ROLL COATING OF ALUMINUM AND ITS ALLOYS. Franzjosef Emonds. Z. Metallk., 52: 615-25(Oct. 1961). (In German)

In order to study the mechanical processes that take place during the coating of aluminum through rolling, a plating diagram was presented to show the dependence of the adhesive strength on the rolling temperature and the rolling rate. Counter measurements revealed the occurrence of surface melting within the zones of the coating planes that caused the sheets to weld together. Above a plating temperature of 300°C an additional welding caused by the following three facts took place simultaneously: deformation, recrystallization, and renewed deformation. During recrystallization the grains grow across the plating plane into the adjoining sheet and become responsible for the weld-together. This grain overgrowth was confirmed by the use of electron microscope. Further observations showed the bridging of grains in the adjoining sheets and were revealed by the grain boundaries that were formed. A small grain-size, soft annealed initial sheets, and plate-milling in the initial direction of rolling favor the welding. Pure Al was found to be most suitable for the plating of Al to the surface of Al–Cu–Mg alloys at low temperatures. It was, however, not easy to deal with the combinations Al 99.5 and Al–Mg_3, Al 99.5 and Al 99.5 and Al 99.9 and Al 99.9. The adhesive strength is increased by relative displacement and friction. According to Fick's laws a diffusion of Cu and Mg into the external zones of the Al sheets is possible even during the short plating periods of 0.07 sec. The adhesive strength is increased. (auth)

10497 WELDING PROBLEMS IN NUCLEAR CONSTRUCTION. Eugene B. LaVelle (General Electric Co., Richland, Wash.) and Frank W. Davis (Southwest Research Inst., San Antonio, Tex.). Review Series No. 20 of "Developments in the Peaceful Applications of Nuclear Energy" of the International Atomic Energy Agency, Vienna. Dec. 1961. 79p. $1.00(IAEA). (HW-SA-2134; STI/PUB/15/20)

The extreme variety of weldments which have been, are being, and will be fabricated for nuclear installations and service pose interesting welding problems. An attempt is made to set forth some of the salient considerations inherent in this work. No effort is extended to delineate much specific detail owing to the ramifications inherent in each application. Any specific item covered is assumed to be a typical weldment involving a typical welding problem. (auth)

10498 EXPLOSIVE METAL FORMING. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Dec. 1961. 6p. SB-441(Rev.) $0.10(OTS)

A bibliography of 66 references is presented on explosive metal forming. (D.L.C.)

Properties and Structure

Refer also to abstract 11271

10499 (AD-267891) STUDIES OF THE REINFORCEMENT OF METALS WITH ULTRA HIGH STRENGTH FIBERS (WHISKERS). Final Report, October 28, 1960–August 27, 1961. Bertram C. Raynes (Horizons, Inc., Cleveland). Nov. 27, 1961. Contract NOw-61-0207-c. 57p.

The feasibility of reinforcing Nichrome or other high-temperature alloys with high-strength aluminum oxide fibers (whiskers) was examined experimentally. The primary problems to be solved were estimated to be the development of a strong bond between the metal matrix and the fibrous nonmetallic reinforcing phases, and also, the development of a method to produce dense composites useful ultimately as structural shapes in which the reinforcing fibers are oriented with respect to stress. An extrusion process for producing such composites with oriented structures was developed and is described. It is one which can be utilized in commercial practice at an anticipated reasonable cost for production of wire, sheet, bar, and uniform cross section of rod stock. Heat treatment in air of a composite containing excess chromium metal resulted in the most significant findings with respect to bond development and a survey. It appeared evident that an alumina-chromia Nichrome bond producing useful strength was caused to form at least in part. A number of other approaches failed to show significant bond formation or reinforcement. (auth)

10500 (APEX-672) HIGH TEMPERATURE LUBRICATION STUDY. E. Haffner, P. Lewis, M. B. Peterson, and A. A. Schwartz (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 63p.

A program was initiated to develop practical lubrication systems for typical ANP applications utilizing available lubricants. The systems of lubricants were developed for the following types of applications: limited movement, continuous motion, and continuous motion where accurate positioning is required at higher speeds and loads. The various lubricants, high temperature supply systems, conventional systems, low temperature systems, selection of lubricant systems, apparatus, development of the pitted surface, oxide studies, adsorption studies, interference fits in composite cylinders, and sprayed surfaces are discussed. (M.C.G.)

10501 (APEX-684) BASIC MATERIALS STUDIES; SINTERABLE HIGH PURITY BeO. Final Report. W. J. Kirkpatrick, G. R. Anderson, and E. S. Funston (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 30, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 45p.

The preparation of high purity, high density, spherical, beryllium oxide powder using beryllium basic acetate as the raw material is discussed. Methods for making the beryllium basic acetate, its conversion to beryllium hydroxide, and finally calcination to beryllia are described. Analytical data are presented showing the high degree of purity obtained by the process, along with the characterization of the low-calcined beryllia powders. (auth)

10502 (AROD-2287.15) HEATS OF FORMATION OF ALLOYS. Final Report, November 1, 1958–October 31, 1961. Raymond L. Orr and Ralph Hultgren (California. Univ., Berkeley. Materials Research Lab.). Dec. 1, 1961. Contract DA-04-200-ORD-171. 10p.

The general study of the factors which influence the thermodynamic properties and atomic bonding of alloys was continued mainly by direct calorimetric measurement of the heats of formation of representative alloy phases. The accomplishments of this study of a wide variety of alloy bonding problems have been reviewed mainly by reference to previous technical reports and published papers which have been submitted. Lists are given of the technical reports, published papers, and graduate theses resulting from this research, and of the scientific personnel employed. (auth)

10503 (ASD-TR-61-73) EFFECT OF CREEP-EXPOSURE ON MECHANICAL PROPERTIES OF RENÉ 41. Jeremy V. Gluck and James W. Freeman (Michigan. Univ., Ann Arbor). Apr. 4, 1961. Contract AF 33(616)-6462. 69p.

René 41 was tensile tested at room temperature after creep-exposure or unstressed exposures of 10 to 200 hours at temperatures between 1200° and 1800°F. Thermally-induced structural changes reduced strength and ductility after exposures above 1500°F, while creep strains caused increased strength and decreased ductility after lower temperatures. Limited data indicated that surface reactions reduced properties in addition to the effects of the creep-exposures. Creep accelerated structural changes and raised yield strength by a Bauschinger effect. Ductility was reduced more after creep than by thermally-induced changes. At 1200° and 1300°F, creep strains approaching the ultimate ductility induced deep cracking. This effect was not found at higher temperatures. The loss in strength from thermal changes appeared to be due to the overaging of the gamma prime precipitate, while losses in ductility were associated with buildup of carbides and agglomeration of gamma prime at the grain boundaries. Surface effects were associated with intergranular oxidation, cracking, and alloy depletion. The role of creep needs further clarification and further study of surface reactions is needed before general principles can be formulated for the influence of creep-exposure on normal temperature mechanical properties. (auth)

10504 (ASD-TR-61-73(Pt.II)) EFFECT OF CREEP-EXPOSURE ON MECHANICAL PROPERTIES OF RENÉ 41. PART II: STRUCTURAL STUDIES, SURFACE EFFECTS, AND RE-HEAT TREATMENT. Jeremy V. Gluck and James W. Freeman (Michigan. Univ., Ann Arbor). June 27, 1961. Contract AF33(616)-6462. 103p.

The effect of creep-exposure on room temperature mechanical properties of René 41 was studied for temperatures of 1200 to 1800°F and times up to 200 hours. Unstressed exposures were for as long as 2012 hours at 1700°F. Thermally-induced structural changes reduced strength and ductility after exposures at 1400 to 1800°F. Reduced yield strength was due to decreased volume fraction of gamma prime and secondarily to an increase in the particle size. Ductility was reduced by formation of massive grain boundary carbides. Up to 1500°F, creep caused strain hardening and Bauschinger effects. Except for surface effects, damage was restorable by re-heat treatment. Yield strength was restored by re-solution and re-aging to produce fine gamma prime. Complete re-solution of carbides was required to restore ultimate strength and ductility. Microcracking was not observed. Creep induced intergranular surface cracking at 1200 to 1300°F which reduced ductility. Surface effects for exposures above 1400°F were thermally induced. General principles were formulated for damage to properties of nickel-base alloys. (auth)

10505 (ASD-TR-61-440) A STUDY OF SUBSTRUCTURE AND CREEP RESISTANCE USING NICKEL, WITH PRELIMINARY DATA FOR NIOBIUM. A. Phillip Coldren and James W. Freeman (Michigan. Univ., Ann Arbor). Aug. 1961. Contract AF33(616)-5466. 64p.

A correlation obtained between instantaneous creep rate and a quantitative measure of the substructure density at the same time during primary creep of nickel at 1550°F and 3360 psi indicated that the development of substructure was responsible for primary creep. The correlation held for substructures developed at higher stress before testing at 3360 psi. These test conditions were used because substructures were developed which could be clearly delineated by etch pitting. Attempts to use lower temperatures failed because the substructures could not be clearly delineated, due either to incomplete polygonization or to precipitation interfering with the decorator effect of impurities. The results did show that the non-homogeneity of substructures requires both high resolution and the ability to average measurements if meaningful quantitative measurements are to be obtained. Attempts to correlate substructures with varied creep-rupture properties at 1100°F from hot rolling failed, due to lack of sufficient polygonization for delineation and to interference with the decorator effect by precipitation. Measurable substructures could not be produced for testing at 1100°F by other means due to the interference by recrystallization when the strain rate was reduced sufficiently for polygonization. Extremely limited data for niobium indicated that creep-rupture properties were influenced by rolling conditions even though there was very little strain hardening in this material. (auth)

10506 (BMI-X-191) ELEVATED TEMPERATURE FATIGUE CHARACTERISTICS OF CORRODED HASTELLOY-X FUEL PIN TUBING. L. G. Beall, A. A. Mittenbergs, and G. M. McClure (Battelle Memorial Inst., Columbus, Ohio). Jan. 31, 1962. Contract [W-7405-eng-92]. 27p.

The investigation was undertaken to determine the elevated temperature fatigue performance of Hastelloy-X weld-drawn tubing that had been subjected to a nitrogen atmosphere for 5000 hr at 1750°F, and to compare the results with existing data for noncorroded tubing. The stress required to produce failure in 10^6 cycles for stress ratios of A = 0.25, 0.95, and ∞ was established for three temperature levels, 1400, 1600, and 1800°F. The data obtained for the corroded tubing are tabulated and shown graphically along with the data for the noncorroded tubing. (B.O.G.)

10507 (CRT-1049) MATHEMATICS OF THE THERMAL DIFFUSION OF HYDROGEN IN ZIRCALOY-2. Anton Sawatzky and Erich Vogt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Oct. 1961. 76p. (AECL-1411)

By means of mathematical solutions to the appropriate diffusion equations the kinetics of the thermal diffusion of hydrogen in Zircaloy-2 are described for the various temperatures and concentrations encountered in a heavy water moderated reactor. When the hydrogen concentration is below terminal solid solubility hydrogen is present only in the α-phase. Redistributions are then described in terms of the characteristic functions of the diffusion equation. For higher concentrations both the α- and δ-phases are present. The two phases were assumed to be always in equilibrium. For moderately small hydrogen concentrations exact solutions of the two-phase equation approached the approximate solutions derived by Sawatzky and for all concentrations the exact solutions exhibit the qualitative features of his result: the two-phase concentration increased with time, everywhere; in the absence of a hydrogen current at the hot end of the sample an α-phase region always exists there; the interface of the $\alpha + \delta$, α-phase boundary moves toward the cold end of the sample and the hydrogen concentration is discontinuous at the interface. Simultaneous solutions of the α- and $\alpha + \delta$ hydrogen distributions and of the concomitant interface motion were obtained and compared to the observations of Sawatzky and Markowitz. The kinetics of the hydrogen diffusion process are shown to lead to an apparent heat of transport of the α-phase which is lower than the actual value (even for samples with long anneals) thus resolving at least partially the disparity between experimental measurements of this quantity. (auth)

10508 (DC-55-5-17) STUDY OF CONDITIONS AFFECTING COMBUSTION OF NICHROME AND STAINLESS STEEL. Warren H. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 29, 1955. 34p.

Experiments on combustion of nichrome and stainless steel are reported. Various consequences are demonstrated and conditions similar to those in reactor tubes following air flow stoppage are examined. (J.R.D.)

10509 (DC 56-3-115) A SUMMARY OF THE PROPERTIES OF COLUMBIUM AND HYDRIDED ZIRCONIUM. J. F. Collins and E. S. Funston (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 7, 1956. Contract AT(11-1)-171. 7p.

Tables containing data on elevated temperature strength, modulus of elasticity vs temperature, coefficient of expansion, and thermal conductivity are presented for Nb. Data on properties of hydrided Zr are also included. (J.R.D.)

10510 (DC 57-3-19) STRUCTURAL PROPERTIES OF MOLYBDENUM ALLOYS AT ELEVATED TEMPERATURES (STRUCTURAL MEMO NO. 8)–MILESTONE REPORT I, TASK 7173. A. L. Ross and B. R. Thompson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 28, 1957. Contract AT(11-1)-171. 31p.

The experimental data taken during an investigation of the elevated temperature properties of molybdenum and its alloys were re-evaluated. The data were re-evaluated so that the results would be in a form more useful to the structural designers and analysts. The use of the Larson-Miller Parameter in the evaluation of the experimental data afforded a more reliable statistical evaluation of the data than was originally used in interpreting the data. A least square approximation was used to determine the best polynomial for describing the stress rupture properties. This required error minimization for determining the coefficients of the polynomial and the physical constant appearing in Larson-Miller Parameter. (auth)

10511 (DC-58-7-45) STATUS OF DEVELOPMENT OF SYNTHETIC ORGANIC FLUIDS FOR USE IN THE TEMPERATURE RANGE FROM ROOM TEMPERATURE TO 1000°F, MILESTONE I, TASK 4334-1-1 (FORMERLY TASK 1470). C. G. Collins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 1, 1958. Contract AT (11-1)-171. 26p.

Progress in programs to develop synthetic organic materials for use at temperatures up to 1000°F is reviewed. Interest in such fluids stems from the requirement for high temperature lubricants and hydraulic fluids for supersonic flight equipment and from the requirement for radiation-stable fluids for the ANP program. Data are presented for three basic types of compounds-poly(phenyl ethers), polyphenyls, and arylsilanes-that are considered to possess the desired thermal and radiation stability. The data indicate that the better fluids examined to date will be useful at 500 to 800°F. The poly(phenyl ethers) possess the best all-round properties. The other two compound types appear comparable to the poly(phenyl ethers) in most respects but exhibit comparatively poor wear properties under high loads. (auth)

10512 (DC-59-5-210) CONSTITUTION OF YTTRIUM ALLOYS. BINARY PHASE DIAGRAMS OF 15 YTTRIUM ALLOY SYSTEMS. J. A. McGurty (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 19, 1959. Contract AT(11-1)-171. 19p.

A handbook is presented of all currently available phase diagrams of yttrium alloys. Phase diagrams are presented for Al–Y, B–Y, Ce–Y, Cr–Y, Cu–Y, Hf–Y, Fe–Y, Mo–Y, Ni–Y, Nb–Y, Si–Y, Ti–Y, Ta–Y, V–Y, and Zr–Y. (M.C.G.)

10513 (DC 59-11-162) NICHROME EVALUATION PROGRAM. R. A. Church (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 20, 1959. Contract AT(11-1)-171. 27p.

A summary of the tasks and jobs for the Nichrome evaluation program is presented. Included are the task and job description sheets, and all job responsibility authorizations for the program. A program schedule for hardware is also included. (auth)

10514 (DC 60-2-112) TESTING OF 304 STAINLESS STEEL METAL BOSS SEALS. J. S. Fitts, Jr. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 9, 1960. Contract AT(11-1)-171. 18p.

A series of tests was performed to determine the sealing effectiveness and reusability of MS 24382 304 SS metal boss seals. These metal boss seals were designed to operate at pressures up to 3000 PSIG and at –65 to 600°F. Results indicate that this type of metal boss seal is unsuitable for the intended application due to gross deformation and galling resulting from the required high tightening loads. (auth)

10515 (DC-60-2-210) CLAD MATERIAL FOR ETR PROGRAM–OXIDATION RESISTANCE OF VARIOUS NiCr ALLOYS. P. T. Ryan (General Electric Co. Aircraft Nuclear Propulsion Dept.). Feb. 17, 1960. Contract AT(11-1)-171. 17p.

Photomicrographs indicate available air melted nichrome is superior in oxidation resistance to one lot of vacuum melted nichrome for use in ETR nichrome evaluation program. Results are also given for creep testing of samples containing 0.1 and 0.3% Th. (auth)

10516 (DC-60-3-35) MILESTONE REPORT ON HYDROGEN PERMEATION OF OXIDIZED METALS AND ALLOYS, JOB 53292. R. M. Haag (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 9, 1960. Contract AT(11-1)-171. 36p.

The mechanisms involved in hydrogen permeation in metals and alloys are discussed. Equations were derived for some special cases sufficient to show that these results are completely consistent with the notion that bulk diffusion of hydrogen through an oxide lattice is the rate controlling step. A system was constructed for use in making precise measurements of the permeation rate at pressures from 10 mm to one atmosphere. The apparatus also allowed controlled oxidation of either the upstream or downstream face of the permeation cell and a study of the kinetics of the oxidation. The effects of oxidation of the diffuser surface were shown by a decrease in the surface permeability constant and then the bulk constant. (M.C.G.)

10517 (DC-60-4-80) COMPILATION OF PROPERTIES OF BERYLLIUM INTERMETALLIC COMPOUNDS. G. C. Huth and J. P. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 11, 1960. Contract AT(11-1)-171. 15p.

Thermal and mechanical property data obtained over the past several years on various Be intermetallic compounds are summarized. References to more recent information are cited. (auth)

10518 (DC-60-11-165) AN INVESTIGATION SEEKING COMMON AND EXTENSION WIRE FOR USE AT HIGH-TEMPERATURE WITH PT VS PT-10% RH THERMOCOUPLES. R. J. Freeman (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 30, 1960. Contract AT(11-1)-171. 92p.

An investigation was performed for the purpose of finding economical extension and/or common wire for use with Pt vs Pt–10% Rh thermocouples in the temperature range 800 to 1,000°F. Both base-metal extension and common wire were found. The cost of the base-metal wire is of the

order of 2 to 3% of the cost of Pt. The investigation treats differential temperatures at the point of connection, thermoelectric characteristics of various metals, circuitry, thermoelectric drift tests, properties other than thermoelectric, and points up the advantages and disadvantages of common as well as extension wire. Secondary treatment was given to connection temperatures in the range 300 to 400°F. (auth)

10519 (DCL 59-8-93) BeO STANDARDS. R. Cooperstein (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 10, 1959. Contract AT(11-1)-171. 19p.

Standard BeO specifications used at Atomics International, Lawrence Radiation Laboratories, and General Electric Aircraft Nuclear Propulsion Department are presented. (M.C.G.)

10520 (DMIC-162) COATINGS FOR THE PROTECTION OF REFRACTORY METALS FROM OXIDATION. C. A. Krier (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Nov. 24, 1961. Contract AF 33(616)-7747. 236p.

The current state of the art of coatings to protect refractory metals from oxidation is summarized. Silicides, aluminides, and oxide-base materials showed the most promise as coatings for accomplishing current objectives. Pack cementation techniques are being used predominantly in producing silicide coatings. Pack cementation, hot dippings, paint, and diffused techniques are being used to prepare aluminide-base coatings. (M.C.G.)

10521 (DMIC-Memo-146) MAGNESIUM–LITHIUM ALLOYS. A REVIEW OF CURRENT DEVELOPMENTS. P. D. Forst (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Feb. 6, 1962. 21p.

Paper presented at the 17th Annual Convention of the Magnesium Association, New York City, October 16, 1961.

The progress made in the development of Mg-Li alloys is reviewed. Phase relationship studies, basis for ternary and complex alloys, alloys of greatest current interest, and uses of the alloys are discussed. (M.C.G.)

10522 (DP-607) MEASUREMENT OF PREFERRED ORIENTATION OF THIN-WALLED ZIRCALOY-2 TUBES. E. F. Sturcken and W. G. Duke (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). May 1961. Contract AT(07-2)-1. 23p.

X-ray diffraction procedures were established for the routine measurement of preferred orientation of zirconium and Zircaloy-2. The inverse pole figure technique was used for interpretation of the x-ray data. When the method was applied to specimens of thin-walled Zircaloy-2 tubing, differences in preferred orientation were revealed that were sufficient to explain anisotropic deformation characteristics that were previously observed in the tubing. (auth)

10523 (DP-622) CREEP OF ALUMINUM–LITHIUM ALLOY. Robert P. Marshall (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 20p.

The tensile creep properties of an aluminum–12 atom % (3.4 wt %) lithium alloy were measured in the temperature range of 150 to 250°C and at stresses of 3300, 5800, and 8500 psi. The second-stage creep rate of the alloy had an activation energy of 31.5 kilocalories per mole and varied with stress raised to the 3.5 power. The creep properties were affected very little by the shape, size, and distribution of the second-phase particles, but were strongly dependent on the grain structure of the matrix. A new metallurgical phenomenon, termed "strain-induced diffusion," was observed, in which lithium diffused to grain boundaries that were oriented normal to the stress and precipitated as continuous, second-phase layers. The appearance and location of the layers suggested that stress concentrations were relieved by the formation of the low-density second phase in preference to the formation of voids or cracks. (auth)

10524 (EOS-1592-Final) HIGH TEMPERATURE SEMICONDUCTING COMPOUNDS FOR THERMOELECTRIC POWER GENERATION. Final Comprehensive Report, December 15, 1960–December 15, 1961. C. B. Jordan (Electro-Optical Systems, Inc., Pasadena, Calif.). Jan. 15, 1962. Includes appendix A: CHEMICAL ANALYSIS PROCEDURES. Jane Doty. Contract NObs-84327. 43p.

An investigation was made of certain sulfides, selenides, and tellurides of U and Th with respect to their potential usefulness as high-temperature thermoelectric materials. Intermediate phases with compositions of the forms MX, MX_2, and M_2X_3 (where M = Th or U, and X = S, Se, or Te) were syntheiszed, and their Seebeck coefficients and electrical resistivities measured as functions of temperature. The only material found to have a Seebeck coefficient sufficiently high to be of particular interest was ThS_2, with a value of 700 μV/°C at 400°C. Determination of the chemical and crystalline composition of the synthesized materials was found to be a serious problem, and it is recommended that any continuation of the work be concentrated on overcoming this difficulty. (auth)

10525 (EURAEC-21) SWELLING OF URANIUM. Quarterly Report No. 1. (Brussels. Centre d'Etude de l'Energie Nucleaire). Dec. 1960. Work performed under United States-Euratom Joint Research and Development Program. Contract [022-60-10-RDB]. 43p.

A research program for finding out whether nucleation of bubbles on dislocations in the rate-controlling process in irradiation swelling of U is described, and pertinent literature is surveyed. The program will be carried out by examining irradiated metal films with the electron microscope, and various methods for preparing thin metal films are reviewed. Experimental results on the preparation and examination of Pt, Nb, Zr, and U films are presented. Pt and Nb films were easily prepared and showed dislocations, while oxide layers formed on Zr films and most of the U films melted under electron microscopic examination. (D.L.C.)

10526 (EURAEC-86) RESEARCH ON ZIRCONIUM ALLOYS WITH NIOBIUM AND/OR SILICON WITH A VIEW TO THEIR USE AS CLADDING MATERIAL IN WATER-COOLED NUCLEAR REACTORS. Quarterly Report No. 4, January 1, 1961–March 31, 1961. K. Anderko, W. Jung-Koenig, H. Richter, P. Winciers, U. Zwicker, K. Sagel, and R. Zimmermann (Metallgesellschaft A. G., Frankfurt am Main). Apr. 17, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract [009-60-4RDA]. 82p.

Constitution tests on the Zr-Nb state system were pursued, and it was found that even in iodide-zirconium-based alloys the monotectoidal reaction $\beta_{Zr} \rightleftharpoons \alpha_{Zr} + \beta_{Nb}$ does not occur at constant temperature. As the result of an unavoidable oxygen content, a three-phase field also occurs here in which the monotectoidal reaction extends over a large temperature interval. The monotectoidal composition was established at 19% Nb. A process to determine the solubility of alpha-Zr for niobium below 570°C is described. The alpha-zirconium solid solution does not age-harden. The comparative corrosion tests conducted during the fourth quarter showed that heat-treatment below the mono-

tectoidal temperature brings about optimum resistance. The effect of heat-treatment is highest in pressurized water at 350°C, but more limited in high-temperature steam. The presence of tin is favorable in pressurized water, unfavorable in high-temperature steam. Addition of palladium has an unfavorable effect. Tests in circulating steam at normal pressure give results similar to tests in high-pressure steam. Zircaloy-2 and ZrNb3Sn1 tubes were fabricated for thermal cycling elongation tests. The first tests carried out showed that thermal cycling brings about a certain contraction of the extrusion-hardened tubes. Tensile tests and micro-tests at room and higher temperatures were performed on the Zircaloy-2, ZrNb2, and ZrNb3Sn1 alloys envisaged for fatigue testing. Current fatigue tests such alloys extended over periods of 500 to 2000 hours. According to the results so far obtained, alloys containing niobium would appear to have a higher fatigue resistance than Zircaloy-2. Even after heat-treatment at 575°C, which is unfavorable for fatigue resistance, though favorable for corrosion resistance. The ZrNb3Sn1 alloy proved to be appreciably superior to Zircaloy-2. (auth)

10527 (GAMD-1059) THERMAL CONDUCTIVITY OF REFRASIL IN HELIUM STATIC INSULATION TEST. H. C. Hopkins and G. F. Poole (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Oct. 23, 1959. Contract AT(04-3)-187. 8p.

The static insulation test was designed to test insulation in a helium atmosphere up to a pressure of 800 psig and a maximum temperature of over 1300°F. A long hollow cylinder of the insulation was tested with heater in the center and the outside cooled by heat transfer to the pressure vessel. The results are presented in graph form. The effect of pressure on the mean thermal conductivity is clearly evident. (M.C.G.)

10528 (HMI-B-19) EXPERIMENTAL METHODS AND EQUIPMENT FOR DIFFUSION MEASUREMENTS OF RADIOACTIVE RARE-GASES IN SOLIDS (RARE-GAS DIFFUSION IN SOLIDS 7). Per Schmeling and Fred Felix (Hahn-Meitner-Institut für Kernforschung, Berlin). Nov. 1961. 42p. (BC-17)

A literature survey is given on the methods and equipment used for the measurement of release of radioactive rare gases in solids, with a discussion of advantages or disadvantages. Continuous methods with sweepgas or circulation and various discontinuous methods are discussed and apparatus used for Hahn emanation-, DAD-, or PAD-experiments are described. In addition, references are given concerning sampling, purifying, and measuring of radioactive rare gases as well as materials to be used for measuring rare-gas diffusion at high temperatures in oxygen-sensible systems. (auth)

10529 (HW-70607) THE IMPACT PROPERTIES OF UNALLOYED PLUTONIUM. H. R. Gardner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1961. Contract AT(45-1)-1350. 21p.

The effect of temperature on the unnotched and notched Charpy impact properties of plutonium was studied in the alpha, beta, gamma, and delta phases encompassing a temperature range of −43 to 330°C. Impact energies for unnotched specimens generally increased with increasing test temperature in the alpha and beta phases. Brittle failures were obtained in these phases. The specimen tested in the gamma phase did not fracture but bent in a U-shape and pulled through the anvil. Impact energies for the Charpy V-notched specimens were much lower than for the unnotched specimens at corresponding temperatures. Brittle failures were obtained in the alpha and beta phases; some ductility was evidenced in the gamma phase while the specimen tested in the delta phase did not fracture but bent in a U-shape. It was concluded that the beta phase is quite sensitive to both strain rate and notch effects. Fracture appearance in the alpha and beta phase is discussed from the standpoint of grain boundary effects and microcracking. (auth)

10530 (HW-71794) BRITTLE FRACTURE OF STEEL, 1950-1961. E. R. Appleby, comp. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 6, 1961. Contract [AT(45-1)-1350]. 43p.

A bibliography on the brittle fracture of steel was compiled from the unclassified literature for the period January 1950 through November 15, 1961. Two hundred and eleven references are given. Author and subject indexes are included. (M.C.G.)

10531 (JPL-TR-32-181) STRUCTURAL AND HIGH-TEMPERATURE TENSILE PROPERTIES OF SPECIAL PITCH-COKE GRAPHITES. H. E. Martens and W. V. Kotlensky (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Nov. 30, 1961. Contract NASw-6. 14p.

The room-temperature structural properties and the tensile properties up to 5000°F (2750°C) were determined for ten grades of specially prepared petroleum-coke coal-tar-pitch graphites which were graphitized at 5430°F (3000°C). One impregnation with coal-tar pitch increased the bulk density from 1.41 to 1.57 g/cm^3 and the maximum strength at 4500°F (2500°C) from 4000 to 5700 psi. None of the processing parameters studied had a marked effect on the closed porosity or the x-ray structure or the per cent graphitization. The coarse-particle filler resulted in the lowest coefficient of thermal expansion and the fine-particle filler in the highest coefficient. A marked improvement in uniformity of tensile strength was observed. A standard-deviation analysis gave a one-sigma value of approximately 150 psi for one of these special grades and values of 340-420 psi for three commercial grades. (auth)

10532 (LM/TAB-19) LIQUID METALS TECHNOLOGY ABSTRACT BULLETIN. Period covered: September 1961 to January 1962. (MSA Research Corp., Callery, Penna.). 14p.

A bibliography of 35 references, most with appended abstracts, is presented on liquid metal technology. (D.L.C.)

10533 (NAA-SR-6551) DIFFUSION OF Au AND Cu IN A TEMPERATURE GRADIENT. C. J. Meechan and Guy W. Lehman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 15, 1962. Contract AT(11-1)-GEN-8. 29p.

Measurements were made of relative marker movements in Au and Cu in the presence of temperature gradients of the order of 1200°K/cm. These experiments yielded results which indicate that a net vacancy current is established in the metals under appropriate experimental conditions. The magnitude and direction of the observed effects are consistent with kinetic theory predictions in conjunction with previously determined vacancy energies. A three-dimensional extension of existing kinetic theory is developed and important factors which do not appear in one-dimensional treatments are discussed. Porosity development in Cu was found under certain conditions, and this may be a visual demonstration of the existence of a thermal diffusion effect in Cu. (auth)

10534 (NMI-2102) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to United States Atomic Energy Commis-

sion for December 1961. (Nuclear Metals, Inc., Concord, Mass.). Feb. 26, 1962. Contract AT(30-1)-2784. 19p.

Conversion of unalloyed Mo arc-cast ingots into a wrought form was successfully accomplished by a two-temperature technique. A series of Mo–Re, Nb–Re, Ta–Re, and W–Re alloys were prepared for hardness measurements. An investigation was made of two mechanisms of zirconium corrosion: failure of thick oxide films and incorporation of foreign ions into the oxide lattice. The relative irradiation-induced swelling characteristics of alpha- and beta-phase uranium were evaluated. Zone-refining operations were continued on $1\frac{1}{4}$-in.-diameter beryllium crystals for use in studies of prism plane slip. The electrical resistivity ratio is being correlated with chemical analyses and mechanical deformation behavior. (M.C.G.)

10535 (NP-10640(Suppl.I)) BERYLLIUM: A SURVEY OF THE LITERATURE, APRIL–JULY 1961. SUPPLEMENT I. Jack B. Goldmann, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Oct. 1961. Contract NORD 17017. 116p. (SB-61-35(Suppl.I))

The annotated bibliography on beryllium covers publications released during the second quarter of 1961. Citations are arranged alphabetically by author under the following headings: alloys; analysis; applications; bibliographies; compounds; fabrication techniques; joining; mineralogy; oxides; powder metallurgy and casting; processing; properties; and miscellaneous. Reference to the use of beryllium in fuels, nuclear reactor applications, effects of radiation, and Cu-Be alloys were omitted. Two hundred and fifty-five references are given. An author index is included. (auth)

10536 (NP-11356) INVESTIGATION OF SINTERABLE POWDERS AND CERAMICS MADE FROM THEM. Fourth Quarterly Report, October 1 through December 29, 1961. C. Hyde, A. Rudnick, M. J. Snyder, and W. H. Duckworth (Battelle Memorial Inst., Columbus, Ohio). Feb. 12, 1962. Contract AF 33(616)-7733. 20p.

Pressing in oil rather than in water was found to improve the strength of sintered MgO specimens which were prepared by calcining $MgCO_3$. The effect of calcining furnace atmosphere on the sintering properties of the resulting MgO was investigated; dried air and dried argon were found to give the same sinterability, but moisture and CO_2 harmed the sinterability. Studies were made on possible causes of the sinterability loss encountered in the scaling up of the calcining process. The triple-cleft failure often observed in the diametral compression test can be considered as tensile failure. (D.L.C.)

10537 (NP-11387) OXIDATION RESISTANT HIGH TEMPERATURE PROTECTIVE COATINGS FOR TUNGSTEN. Third Quarterly Progress Report, November 1, 1961–January 31, 1962. (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Feb. 15, 1962. Contract AF33(616)-8188. 50p. (TM-3323-67)

Continued investigation is reported on formation and properties of bonded-metal ceramic coatings for W. Studies were also continued on vacuum pack deposition of Ti, Zr, Y, Si, and co-deposition of B, and W with various combinations of these metals to form surface diffusion alloys with W sheet. Seven coated W systems were evaluated in cyclic oxidation tests at 2500, 3000, and 3300°F. W protection was effected at 2500°F for 36 hrs under cyclic conditions and at 3300°F for 10.3 hrs with five cycles to room temperature. The high temperature oxidation furnace operated for 1200 hrs during the period at temperatures above 3000°F. (J.R.D.)

10538 (NP-11400) DEVELOPMENT OF ADHESIVES WITH IMPROVED HEAT RESISTANCE IN BONDS OF STAINLESS STEEL. Final Report. J. M. Black and R. F Blomquist (Forest Products Lab., Madison, Wis.). July 1961. 19p. (FPL-1883)

Adhesives containing combinations of polyamide resin with melamine compounds, epoxy resins with vinyl anhydride copolymers, and inorganic fillers were studied as heat-resistant bonding agents for stainless steel. Attempts to improve the strength of the polyamide-melamine type adhesive at 550°F were unsuccessful. Studies were made of the heat-resistant properties of eight different epoxy resins modified with an ethyl acrylate-maleic anhydride copolymers and with maleic anhydride. The most promising of these were adhesive formulations of epoxy resins which were glycidyl ethers of either bisphenol A or tetrakis (hydroxyl phenyl) ethane and contained aluminum powder and arsenic pentoxide fillers impregnated into asbestos cloth. (auth)

10539 (NP-11402) HARD PARTICLE STRENGTHENING OF REFRACTORY METALS FOR HIGH TEMPERATURE USE THROUGH INTERNAL OXIDATION. Final Report, January 1, 1961–December 31, 1961. A. S. Buffered, K. M. Zwilsky, and N. J. Grant (New England Materials Lab., Inc., Medford, Mass.). Contract NOw-61-0316-C. 37p.

Molybdenum–1.5% titanium powder in the 2 to 50 micron size range was internally oxidized by the formation of a molybdenum dioxide film on the powder particles and titania formation during a diffusion-sintering treatment. Diffusion-sintering was carried out in an argon or hydrogen atmosphere to investigate the effects of this atmosphere on the resultant structure. Fabrication of molybdenum base powder compacts was improved by prior hot upsetting and vacuum canning before extrusion of alloy billets. The most successfully extruded alloys had a recrystallization temperature in excess of 2800°F and a yield strength greater than the tensile strength of arc cast molybdenum–1.5% titanium at 2200°F. (auth)

10540 (NUMEC-P-37) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Monthly Progress Letter for Month of January 1962. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). Feb. 5, 1962. Contract AT(30-1)-2389. 8p.

Development work leading to comparison of co-precipitated and mechanically blended UO_2–PuO_2 powders is reported in which special emphasis was placed on blending trials, pellet sintering studies, and subsequent evaluation of pellets made with blended material. Homogeneity studies indicate that currently used procedures are unsatisfactory because particle buildup occurs during blending. Powder preparation via the oxalate route was continued along with PuO_2 moisture pickup studies. Homogeneous precipitation studies on UO_2 were continued to determine feasibility of direct preparation of dense UO_2–PuO_2 feed materials. Plasma-torch-produced PuO_2 spheres are being evaluated. (J.R.D.)

10541 (ORO-524) SIXTH MONTHLY REPORT ON DETERMINATION OF TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Frank J. Digesu (Southern Research Inst., Birmingham, Ala.). Feb. 14, 1962. Contract AT(40-1)-2694. 5p.

Additional runs were made to further evaluate system performance and to gain experience in operating technique. Data were obtained for the ultimate tensile strength of ZTA graphite. Several types of specimen configurations were investigated during the month. The electrode connec-

tors on the graphite furnaces were modified during the month. (M.C.G.)

10542 (TID-14740) TRANSITIONS IN CHROMIUM. Technical Report No. 1. Jean-François Marin (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Jan. 1962. Contracts AT(04-3)221 and Nonr-220(30). 84p.

The presence of a transition in pure chromium around 40°C (from 25 to 65°C according to the specimen investigated) is evidenced by the anomalous behavior of various physical properties in the vicinity of the transition. Four different properties, electrical resistivity, Young's modulus and Poisson's ratio, Hall coefficient, and specific heat, were investigated on some of five different specimens in temperature ranges including the transition temperature. The shape and magnitude of the observed anomalies for different properties and different specimens were compared, together with the possible effect of impurities on the transition. The relationship between these anomalies and the transition from an antiferromagnetic to a paramagnetic structure is discussed in connection with neutron diffraction experiments and anomalies in other antiferromagnetic materials reported by other workers. (auth)

10543 (TID-14773) DIFFUSION IN LIQUID ALLOYS. Technical Progress Report, January 31, 1961–December 31, 1961. Richard E. Grace (Purdue Univ., Lafayette, Ind. School of Metallurgical Engineering). Jan. 10, 1962. Includes Appendix: KINETICS OF DISSOLUTION OF ROTATING ALUMINUM CYLINDERS IN LIQUID BISMUTH. T. L. Sri Krishna and R[ichard] E. Grace. Contract AT(11-1)-359. 22p.

The self-diffusion of Zn in liquid Pb–0.1 to 1.5 wt.% Zn alloys is studied at 400 to 550°C. Chemical diffusion in ternary alloys is discussed. The corrosion of Cu by liquid Pb under turbulent flow conditions is studied in an isothermal loop at 350 to 500°C. The kinetics of dissolution of Al cylinders rotating at high Reynolds numbers in liquid Bi is studied at 300 to 600°C. (T.F.H.)

10544 (TID-14954) PHASE I. COMPLETION OF THE BINARY PHASE DIAGRAM, NIOBIUM–ALUMINUM. PHASE II. DETERMINATION OF THE NIOBIUM-RICH REGION OF THE TERNARY PHASE DIAGRAM, NIOBIUM–ALUMINUM–ZIRCONIUM. Monthly Letter Report No. 5, January 1, 1962–February 1, 1962. Charles E. Lundin and Albert S. Yamamoto (Denver. Univ. Denver Research Inst.). Feb. 8, 1962. Contract AT(11-1)-1092. 4p.

The tentative solvus curve in the Nb-rich region of the Al–Nb phase diagram was determined. Metallographic and x-ray studies of annealed Al–Nb alloys containing 28.5 to 42.0 at. % Al indicate that the homogeneity range of the intermediate phase Nb_2Al is rather narrow, from 28.5 to 36 at. % Al. (D.L.C.)

10545 (TID-15069) A DELAY TIME IN THE ALPHA TO GAMMA TRANSFORMATION IN IRON. Technical Report No. 3. Olaf A. Boedtker and Pol Duwez (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Mar. 1962. Contracts AT(04-3)-221 and Nonr-220(30). 58p.

Iron, containing a certain amount of C and N, was pulse-heated from an initial temperature in the alpha phase into a final temperature within the gamma phase. The bulk of the allotropic transformation took place a certain time after the final temperature had been reached. The relationship between this delay time and the final temperature follows an Arrhenius type rate equation with a heat of activation of 20,500 ± 1400 cal per mole. The effect of the rate of heating on the alpha to gamma transformation temperature was also measured. It was shown that if the rate of heating is above about 14,000°C per second, it is possible to heat Fe from the alpha to the delta phase, without any intermediate transformation into gamma. (auth)

10546 (UCRL-6652) GETTERING OF RESIDUAL GASES AND THE ADSORPTION RATE OF HYDROGEN ON EVAPORATED MOLYBDENUM FILMS AT LIQUID NITROGEN TEMPERATURES. Angus L. Hunt, Charles C. Damm, and Earl C. Popp (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 18, 1961. Contract W-7405-eng-48. 28p.

Mass spectrometric results indicated that an evaporated molybdenum film deposited on a water-cooled substrate in an ultrahigh vacuum system is a broad spectrum getter. The partial pressures of all residual gas components with mass-to-charge ratios of less than 45 were reduced with the exception of the inert gases. Evaporating molybdenum on a substrate at liquid nitrogen temperature further reduced the total residual pressure in the vacuum system and specifically reduced the partial pressure of argon to below the mass spectrometer sensitivity limit of 1×10^{-9} mm Hg. The maximum hydrogen pumping speed or sticking probability on molybdenum films at liquid nitrogen temperature was more than twice that at room temperature. It was also found that the rate of hydrogen adsorption or hydrogen sticking probability on liquid-nitrogen-cooled molybdenum films is not a monotonically decreasing function of the quantity of hydrogen adsorbed. (auth)

10547 (APEX-614) METALLOGRAPHIC STUDY OF THE SYSTEM ZrH_x. D. Whitwham. Translated by R. VanHouten (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati) from Mém. sci. rev. mét., 57: 1-15(Jan. 1960). 29p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 16011.

10548 (FTD-TT-61-285) SOME PROBLEMS IN THE PHYSICS OF METAL FAILURE. CHAPTER V. P. O. Pashkov. Translated from p.135-84, Chapt. V, of "Razryv Metallov." (Metal Failure). A Publication of the Shipbuilding Industry Leningrad, 1960. 67p.

The propagation of cracks in metals is considered. The effects of time, elevated temperature, and external medium on metal failure are discussed. Finally, some submicroscopic phenomena in metal deformation and failure are described. (D.L.C.)

10549 HIGH PRESSURE INVESTIGATIONS ON BARIUM TITANATE CERAMICS. Martin Richard. Ann. Physik (7) 8: 333-41(1961). (In German)

The effect of a hydrostatic pressure up to 4000 kp/cm^2 on the dielectric constant and the loss angle was investigated on solid solutions of barium titanate with strontium titanate and lead titanate. In addition to the time behavior of these parameters on application or removal of the hydrostatic pressure, the displacement of the curves of the dielectric constants and the losses over the temperature caused by the pressure were measured on a sample with 45°C Curie temperature. From the results it was concluded that the pressure inhibits the motion of domain walls. (tr-auth)

10550 DIFFUSION AND MOBILITY OF TRITIUM IN TANTALUM. J. Wesołowski, J. Jarmuła, and B. Rozenfeld (Inst. of Physical Chemistry, Polish Academy of Sciences, Wrocław). Bull. acad. polon. sci. Ser. sci. chim., 9: 651-5(1961). (In English)

An investigation was made of the state of cathodically occluded hydrogen in tantalum. In order to demonstrate the expected migration of hydrogen, d-c was passed through several charged wires for different periods of time. At the same time the mobility and the diffusion coefficient of tritium were determined. The average values of D and μ obtained from 6 individual measurements were: $D = 3.5 \times 10^{-6}$ cm^2 sec^{-1}, and $\mu = 1.1 \times 10^{-5}$ cm^2 v^{-1} sec^{-1}. The diffusion coefficient was also measured in the absence of a d-c field and $D = 2.3 \times 10^{-6}$ cm^2 sec^{-1} was obtained. (P.C.H.)

10551 DIAGRAM OF STATES OF Cr–Ni–Nb. V. M. Svechnikov and V. M. Pan (Inst. of Metal Physics, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk. Ukr. R.S.R., No. 10, 1290-5(1961). (In Ukrainian)

A constitution diagram of Cr–Ni–Nb with a Cr–Ni–Ni_3Nb–$NbCr_2$ quadrangle was constructed. A four-phase peritectic equilibrium was found at 1175 ± 5°C, four-phase eutectic equilibrium at 1173 ± 5°C, and a four-phase peritectoid equilibrium at 1160 ± 5°C. It is shown that a quasibinary section, $NbCr_2$–Ni_3Nb, appears in the system limited by the Cr–Ni–Ni_3Nb–$NbCr_2$ quadrangle. With 5 to 7% Ni, a β phase based on low-temperature modifications of $NbCr_2$ was replaced by an ϵ phase on a base of high-temperature $NbCr_2$. (auth)

10552 BERYLLIA. ENGINEERED SPACE AGE MATERIAL. P. S. Hessinger (National Beryllia Corp., Haskell, N. J.). Ind. Eng. Chem., 54: No. 3, 16-21(Mar. 1962).

Beryllium oxide possesses a combination of unique thermal, electronic, and nuclear properties not found in other materials, and it is therefore useful to the missile, electronic, and nuclear industries. The preparation of beryllia is discussed briefly with respect that the material may now be produced by standard ceramic methods, thus bringing beryllia structures into reasonable cost ranges. Raw material preparation, isostatic pressing, dry pressing, and extrusion processes are briefly outlined. Safety problems in fabrication and size limitations due to fabrication equipment size are also discussed. (N.W.R.)

10553 TEMPERATURE EFFECTS ON ELECTRIC CONDUCTIVITY AND HALL EFFECTS IN METALLIC GADOLINIUM. N. V. Volkenshtein and G. V. Fedorov (Inst. of Metal Physics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1379-82(Nov. 1961). (In Russian)

Studies were made of the electric and galvano-magnetic properties of Gd possessing unfilled 4-f shells. The Hall coefficients plotted as functions of temperature show the maximum spontaneous Hall coefficient at the Curie point, with different curve geometry for the paramagnetic and ferromagnetic regions. A linear relation was observed for R_s and $\Delta\rho$ at 78 to 270°K. However, at lower temperatures the ratio does not hold. Comparisons are made of the Hall effects in Gd and Ni in order to determine if the Hall effect in ferromagnetics is determined by spin-orbit interactions. (R.V.J.)

10554 MAGNETIC PROPERTIES OF TERBIUM AND HOLMIUM. K. P. Belov, R. Z. Levitin, and S. A. Nikitin (Moscow State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1382-4(Nov. 1961). (In Russian)

The magnetic properties of Tb and Ho are analyzed, and the modulus of elasticity and internal friction are plotted for longitudinal and torsional oscillations. (R.V.J.)

10555 MAGNETIC AND MAGNETOCALORIC EFFECT IN URANIUM HYDRIDE AND DEUTERIDE. A. I. Karchevskii and E. M. Buryak. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1387-8(Nov. 1961). (In Russian)

The magnetization of UH_3 and UD_3 at 4.2 and 77.4°C was investigated in fields of 23 k Gauss. The temperature dependence of magnetization and the magnetocaloric effect at the Curie point were analyzed, and paramagnetic susceptibility was measured at 230 and 500°K. (R.V.J.)

10556 MAGNETIC ANISOTROPY AND HYSTERETIC PROPERTIES OF RARE EARTH ORTHOFERRITES. K. P. Belov, M. A. Zaitseva, A. M. Kadomtseva, and V. A. Timofeeva (Moscow State Univ.). Izvest. Akad. Nauk S.S.S R., Ser. Fiz., 25: 1389-92(Nov. 1961). (In Russian)

Monocrystals of La, Pr, Nd, Sm, Eu, Gd, and Yb orthoferrites were prepared by spontaneous crystallization in oxide and fluoride lead melts, and the mechanical torsion moments in relation to the turning angle were measured. (R.V.J.)

10557 FERROMAGNETICS WITH MAGNETOPLUMBITE AND GARNET STRUCTURES IN HIGH PULSED MAGNETIC FIELDS. G. A. Smolenskii and A. A. Andreev (Inst. of Semiconductors, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1392-5(Nov. 1961). (In Russian)

Magnetic saturation and spin configuration of prepared rare earth hexaferrites were investigated, and non-linear spin distributions in rare earth garnets were analyzed. The solid solutions were of the type $(1 - x)\ Ba^{2+}Fe_{12}^{3+}O_{19} - xM^{3+}\ Fe_{11}^{3+}M^{2+}O_{19}$, where $M^{3+} = La^{3+}$, Pr^{3+}, and Bi^{3+} and $M^{2+} = Co^{2+}$ and Ni^{2+}. Magnetic saturation in such solid solutions is reduced when the second component is increased. (R.V.J.)

10558 MAGNETIC PROPERTIES OF FERROMAGNETICS WITH PEROVSKITE TYPE STRUCTURE. G. A. Smolenskii, V. P. Polyakov, and V. M. Yudin. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1396-8(Nov. 1961). (In Russian)

An attempt was made to produce ferromagnetics with Perovskite structure using $LaFeO_3 - Sr(Ni_{0.5}W_{0.5})O_3$. The first compound has antiferromagnetic properties, while the second is a paramagnetic with ordered Ni^{2+} and W^{6+} ion distribution in octahedric positions. The polycrystalline specimens were prepared from finely crushed oxides, twice annealed at 1100 and 1350°C. An x-ray-diffraction analysis indicates a solid solution of Perovskite structure. The magnetic saturation is plotted as functions of temperature and second component concentration. (R.V.J.)

10559 TEMPERATURE DEPENDENCE OF THE FIRST ANISOTROPY CONSTANT AND THE MAGNETIC STRUCTURE IN IRON–MANGANESE FERRITES. L. V. Kirenskii, A. I. Drokin, V. D. Dylgerov, N. I. Sudakov, and E. K. Zagirova (Inst. of Physics, Siberian Branch, Academy of Sciences, USSR; Kalinin Inst. of Non-ferrous Metals, [USSR]; and Krasnoyarsk Pedagogical Inst., [USSR]). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1472-6(Dec. 1961). (In Russian)

The temperature dependence of the first constant of magnetic anisotropy is investigated in monocrystals of $MnFe_2O_4$ prepared with an excess of manganese. Previous measurements on cobalt ferrites have shown that the following relationship holds: $K = K_0 e^{-aT^2}$, where K is the desired constant, K_0 is the value of the constant at 0°K, a is fixed and T is the absolute temperature. The experimental method consists of measuring the mechanical moment in the crystal plane (100) as a function of an external magnetic field. The moment M is related to K as follows: $M = K/2 \sin 4\Psi$ where Ψ is the angle between the magnetic field direction and the plane (100). A straight

line relationship is found to hold for lnK when plotted against T^2. A value of 17×10^4 erg cm^{-3} is found for K_0. The structure of domains in the plane (110) is investigated as a function of the magnetic field. A sharp change occurs when the field is raised to greater than 760 oersteds. New domain boundaries appear that run across the originally present boundary lines. (TTT)

10560 ON THE QUESTION OF THE NATURE OF THE STRENGTH COEFFICIENT IN ALNICO ALLOYS. A. S. Ermolenko and Ya. S. Shur (Inst. for Physics of Metals, Academy of Science, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1479-83(Dec. 1961). (In Russian)

A study was made of magnetic properties of monocrystals of an alloy containing 24% Co, 14% Ni, 8% Al, 3% Cu, and 51% Fe. The work was done to determine the reason behind the different strength coefficients of alnico alloys depending on whether they are type I or II. The two types arise from the difference in treatment received by the alloy. If the temperature at which the alloy is single-phased (1250°C) is lowered sharply, type I is formed; if the temperature is lowered with a particular speed (1.5 degree per second) then type II is produced. In the type I process a structure is formed in which the particles are widely dispersed in all dimensions and because of this the structure cannot achieve the same strength coefficient as in the case of the type II process. For the latter process with its slower cooling the structure can assume separation dimensions to give the high strength coefficient. (TTT)

10561 INVESTIGATION OF HYSTERESIS IN MAGNETIC ROTATIONS IN COLD ROLLED AND RECRYSTALLIZED NICKEL. N. L. Bryukhatov and N. A. Grincher (Moscow Inst. for Engineers of Railroad Transport). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1486-91(Dec. 1961). (In Russian)

The investigation was carried out using electrolytic nickel containing only 0.03% impurities, including 0.012% cobalt. The samples were in the form of disks with 15 mm diameters and thicknesses of 0.125 mm. These disks were suspended in a magnetic field by means of gauged, elastic threads and the amount of rotation caused by the field was measured by the twist in the threads. The loss due to hysteresis was determined by the difference in rotation when the field direction was reversed. This was done for samples annealed at various temperatures, all in vacuum, for one half hour. It was found that the relationship $Q_R = Ae^{-BH}H$ described the hysteresis loss beginning at the "anisotropy point" in the magnetization curve; for monocrystals and samples with "cubic texture" the relationship held for small magnetic fields also. "Q_R" is the rotational loss due to hysteresis, H the magnetic field, while A and B are constants that are determined from the experimental curves. (TTT)

10562 PLUTONIUM FUEL AND NUCLEAR POWER. A. B. McIntosh and L. Grainger (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). J. Brit. Nuclear Energy Soc., 1: 3-13(Jan. 1962).

The technology used in developing reactor fuel elements of plutonium is summarized and reviewed. Information is presented on the fabrication, canning, irradiation behavior, safe handling, physical properties, economics, uses, crystal structure, metallurgy, metallic phases, reprocessing, and future developments of plutonium fuels. The types of fuels discussed include metallic alloy systems, ceramic fuels (carbide and oxide types), dispersion fuels (metallic, cermet, and ceramic systems), and impregnated fuels. The bibliography contains over 140 references. (N.W.R.)

10563 NEUTRON DIFFRACTION STUDIES OF CaC_2, YC_2, LaC_2, CeC_2, TbC_2, YbC_2, LuC_2, AND UC_2. Masao Atoji (Argonne National Lab., Ill. and Iowa State Univ. of Science and Tech., Ames). J. Chem. Phys., 35: 1950-60 (Dec. 1961).

The complete-matrix least-squares analysis on the neutron diffraction intensities of CaC_2, YC_2, LaC_2, CeC_2, TbC_2, YbC_2, LuC_2, and UC_2 yielded the C–C distances in the C_2 groups, 1.191 ± 0.009, 1.275 ± 0.002, 1.303 ± 0.012, 1.283 ± 0.004, 1.293 ± 0.009, 1.287 ± 0.010, 1.276 ± 0.012, and 1.340 ± 0.007 Å, respectively. The statistical averages of the neutron scattering amplitudes obtained from the dicarbide data and those reported previously are 0.488 ± 0.007, 0.796 ± 0.009, 0.832 ± 0.014, 0.482 ± 0.006, 0.756 ± 0.020, 1.262 ± 0.012, 0.73 ± 0.02, and 0.851 ± 0.022, all in 10^{-12} cm with positive sign, for Ca, Y, La, Ce, Tb, Yb, Lu, and U, respectively. The paramagnetic scattering analyses revealed that all metal atoms in these dicarbides are in their trivalent Hund ground state, except Ca(divalent), Yb (possible valency of 2.8), and U (possible tetravalent). The scattering data also deduced the screening constants for the 4f electrons in Ce, Tb, and Yb as 39, 43, and 43, respectively, which are compared with those obtained by other methods. The bond numbers for the rare-earth dicarbides are briefly discussed. (auth)

10564 NEUTRON-DIFFRACTION STUDIES OF La_2C_3, Ce_2C_3, Pr_2C_3, AND Tb_2C_3. Masao Atoji (Argonne National Lab., Ill) and Donald E. Williams. J. Chem. Phys., 35: 1960-6(Dec. 1961).

The neutron diffraction data of the rare-earth sesquicarbides with the Pu_2C_3-type structure ($D5_c$ type), La_2C_3, Ce_2C_3, Pr_2C_3, and Tb_2C_3, were analyzed using the complete-matrix least-squares method. These sesquicarbides contain the C_2 groups with the C–C distances, 1.236 ± 0.009, 1.276 ± 0.005, 1.239 ± 0.003, and 1.240 ± 0.005 A, respectively, for La_2C_3, Ce_2C_3, Pr_2C_3, and Tb_2C_3. These values are, except for Ce_2C_3, significantly longer than the C–C distance in CaC_2, 1.191 A, but are shorter than the average C–C distance in the rare-earth dicarbides, 1.278 A. The paramagnetic scattering analyses show that all metal atoms in these sesquicarbides are in their trivalent Hund ground state, except Ce in Ce_2C_3, whose possible valency is about 3.4. The screening constants for the 4f hydrogenic radial wave functions of Pr and Tb as determined from the diffuse scattering analyses of their sesquicarbides are 40 and 43, respectively. The valency and metallic bonds in these sesquicarbides are briefly discussed. (auth)

10565 Fe^{57} MÖSSBAUER EFFECT IN LAVES PHASES CONTAINING Fe COMBINED WITH Y, Ce, Ho, Ti, Zr, AND Hf. W. E. Wallace and L. M. Epstein (Westinghouse Electric Corp., East Pittsburgh). J. Chem. Phys., 35: 2238-40(Dec. 1961).

Resonant absorption of γ rays by Fe^{57} (Mössbauer effect) was used to determine the nuclear hyperfine field, quadrupole splitting (ϵ), and the center shift for a number of Laves phases. Magnetic examination indicated that most of the samples studied were ferromagnetic at or slightly below room temperature. The hyperfine patterns were as anticipated in most cases, $TiFe_2$ and ZrFeCo being notable exceptions. Results for ZrFeCo were unusual in that only a doublet was observed at 78°K even though this was well below its T_c. For $TiFe_2$ results were also very unusual. At 78°K the pattern revealed a strong doublet superimposed on the sextet produced by a nuclear hyperfine field of 92 koe. From the magnetic work it is inferred that the coupling is antiferromagnetic. The ϵ values for all samples were small. (P.C.H.)

10566 X-RAY STUDY OF PHASE TRANSFORMATIONS IN SOME RARE-EARTH OXIDE SYSTEMS. R. L. Mozzi and O. J. Guentert (Raytheon Co., Waltham, Mass.). J. Chem. Phys., 36: 298-301(Jan. 15, 1962).

The cubic to hexagonal phase transformation of the systems $Nd_2O_3-Sm_2O_3$ and $Nd_2O_3-CeO_2$ was studied by x-ray-diffraction methods for zero to 20% atomic substitution of Nd by Sm or Ce. Diffraction patterns were obtained at room temperature after heat treatments between 600° and 1400°C. The patterns indicate that at elevated temperature the oxides containing Ce form a solid solution of the approximate cation composition 75% Nd-25% Ce together with excess Nd_2O_3. At 1400°C the solid solution was found to be cubic and the excess Nd_2O_3 to be hexagonal. The oxides containing Sm form solid solutions with cation ratios corresponding to those of the original mixture. They transform into the hexagonal phase via a monoclinic phase which is isomorphous with the B form of Sm_2O_3. Preferred orientation effects were observed on pressed powder disks of Eu_2O_3 and Nd_2O_3 below and above their respective transition temperatures. They support an approximate identification of the monoclinic a, b, and c axes with cubic $[1\bar{1}0]$, [110], and [001] directions and suggest the equivalence of the hexagonal c axis and cubic [111] direction. (auth)

10567 HIGH-TEMPERATURE EVAPORATION AND THERMODYNAMIC PROPERTIES OF ZIRCONIUM DIBORIDE. James M. Leitnaker (Los Alamos Scientific Lab., N. Mex.), Melvin G. Bowman, and Paul W. Gilles. J. Chem. Phys., 36: 350-8(Jan. 15, 1962).

Vapor pressures of zirconium over zirconium diboride were measured by the Knudsen technique over the temperature range 2150 to 2475°K. A new type of apparatus was constructed and used successfully. Zirconium diboride was determined to evaporate congruently at a composition of $ZrB_{1.906(+0.025\ or\ -0.010)}$ by heating solid pressed plugs of both zirconium-rich and boron-rich material to constant composition at 2400 to 2500°C. The over-all reaction is $ZrB_{1.906}(s) = Zr(g) + 1.906\ B(g)$. Three series of measurements were made using tungsten crucibles and different orifice sizes. Second- and third-law treatments of the data did not agree. Thermodynamic calculations were made which indicated that water vapor at low background pressures would produce volatile oxides of both zirconium and boron. This reaction was investigated by adding water vapor to the system and the increased transport of zirconium was clearly demonstrated. Accordingly, each pressure measurement was corrected by a factor β, constant for each series, related to the background pressure. From the corrected pressures, values of ΔH_0° for the reaction were computed by the third-law treatment. From the three series a vaporization coefficient of 0.025 ± 0.010 was computed, leading to an equilibrium ΔH_0° of 458.3 ± 6.5 kcal/mole for reaction 1, or a partial pressure of Zr over $ZrB_{1.906}$ of 2.38×10^{-10} atm ± 20% at 2000°K. The variance between this and an expected value of 477.4 kcal/mole is presumed to be related, at least in part, to discrepancies in the heat of vaporization of zirconium. The results verify the prediction that the Zr-B system exhibits a congruently evaporating phase and suggest that the congruently evaporating composition in many high-temperature systems will occur at nonstoichiometric compositions. (auth)

10568 NUCLEAR MAGNETIC RESONANCE IN METAL TUNGSTEN BRONZES. W. H. Jones, Jr., E. A. Garbaty, and R. G. Barnes (Ames Lab., Ames, Iowa). J. Chem. Phys., 36: 494-9(Jan. 15, 1962).

The nuclear magnetic resonances of Li^7, Na^{22}, and $Tl^{203,205}$ were studied in metal tungsten bronzes (M_xWO_3) in those composition ranges (x values) which possess metallic properties as evidenced by their electrical conductivity. In all cases, the shifts of these resonances with respect to diamagnetic reference compounds were found to be extremely small, indicating that the nuclei of the metal atoms do not interact with the conduction electrons as in the case of ordinary metals. This appears to result from the occurrence of either a radial or an angular node in the conduction band wave functions at the metal atom positions. In the case of the thallium tungsten bronze, linewidth results indicate the presence of indirect nuclear spin exchange interactions. (auth)

10569 DECOMPOSITION PRESSURE OF UCd_{11}. Ewald Veleckis, Harold M. Feder, and Irving Johnson (Argonne National Lab., Ill.). J. Phys. Chem., 66: 362-3 (Feb. 1962).

Cadmium was evaporated isothermally from approximately 250 mg of powdered uranium-cadmium alloy contained in tantalum effusion cells at 305 to 378°C until no further changes in sample weights were observed. A cell with a large orifice yielded observed decomposition pressures 9% lower than a cell with a smaller orifice. This suggests that the evaporation coefficient, α, of cadmium from UCd_{11} is less than unity. Decomposition pressure and standard free energy of formation data are tabulated. (P.C.H.)

10570 THE CRYSTAL STRUCTURE OF $NiZrH_3$. William L. Korst (Atomics International, Canoga Park, Calif.). J. Phys. Chem., 66: 370-2(Feb. 1962).

Evidence showing that the crystal structure of the hydride, NiZrH3, is an expanded version of that of the parent compound, NiZr, is given. The crystal structure reported for NiZr is also confirmed. The values for the cell constants for NiZr were: $a = 3.2581 \pm 0.0003$, $b = 9.941 \pm 0.001$, and $c = 4.0937 \pm 0.0005$ Å. Cell constants obtained for both the hydride and deuteride phases were: hydride phase, $a = 3.53 \pm 0.01$, $b = 10.48 \pm 0.02$, and $c = 4.30 \pm 0.01$ Å; deuteride phase, $a = 3.51 \pm 0.01$, $b = 10.44 \pm 0.02$, and $c = 4.30 \pm 0.01$ Å. A comparison was also made of the observed and calculated x-ray diffraction data for the hydride phase. The agreement was sufficiently good to warrant the conclusion that the structure of the hydride is an expanded version of that of the alloy. (P.C.H.)

10571 WORK FUNCTION OF URANIUM CARBIDE. B. J. Hopkins (The University, Southampton, Eng.). Nature, 193: 668-9(Feb. 17, 1962).

The method for measuring the work function of uranium carbide is described. The Zisman modification of the Kelvin vibrating condenser technique is applied to measure the contact potential difference between a clean tungsten reference surface and the uranium carbide cathode. The work function is found to be 3.97 ev. The work function is of importance since uranium carbide has assumed value as a cathode material for use in a thermionic converter. The method for preparing the uranium carbide cathodes is also described. (N.W.R.)

10572 STRUCTURE OF GRAPHITE. E. J. Freise (Cambridge Univ.). Nature, 193: 671-2(Feb. 17, 1962).

Recent observations of deformation and twinning in graphite single crystals provide an explanation for the satellite spots observed by Lukesh on c-axis precession photographs of single crystals without introducing a second structural modification. The additional satellite spots can be readily explained on the basis of the original Bernal hexagonal structure containing twins without introducing an orthorhombic superlattice cell. The hexagonal spots also found by Lukesh, which are due to diffraction from two or

three crystals twisted relative to one another about their common c-axis, can be considered as localized twist boundaries with no long-range distortion of the hexagonal carbon nets. (N.W.R.)

10573 FISSION PRODUCTS AND PLUTONIUM MIGRATE IN URANIUM-DIOXIDE FUEL. J. Lambert Bates, James A. Christensen, and William E. Roake (General Electric Co., Richland, Wash.). Nucleonics, 20: No. 3, 88; 90(Mar. 1962).

Experimental results show that several fission products and plutonium formed in uranium dioxide fuel elements tend to accumulate more in some fuel zones than in others. It is also shown that this accumulation affects core reactivity, fuel swelling, and fuel sampling methods used in determining burnup. The mechanisms and significance of the migration are given. (N.W.R.)

10574 INTERACTION OF $CaZrO_3$ WITH SOME OXIDES AT HIGH TEMPERATURES. E. K. Keler and A. B. Andreeva. Ogneupory, 26: No. 12, 581-6(1961).

The interaction of $CaZrO_3$, synthesized at 1350, 1500, or 1600°C, with pure ZrO_2, TiO_2, SiO_2, ThO_2, and Al_2O_3 at high temperatures was studied. Pressed and fired disk-shaped specimens of $CaZrO_3$ were heated in a Silit furnace for 2 hr at 1350 to 1450°C in contact with specimens prepared from the oxides, and placed on disks. After heating, the disks were subjected to chemical analysis, which showed that $CaZrO_3$ begins to react with SiO_2 and TiO_2 at 1350°C, while with ZrO_2, ThO_2, and Al_2O_3 there is no reaction even at 1450°C. Next specimens of equimolecular mixtures of $CaZrO_3$ with the oxides were fired at 1350, 1400, 1450, and 1500°C for various periods of time and subjected to chemical, x-ray diffraction, and dilatometric analysis. $CaZrO_3$ was found to decompose when fired at 1500°C in the presence of ZrO_2, SiO_2, TiO_2, or Al_2O_3, forming with ZrO_2 the solid solution ZrO_2–CaO, with SiO_2 calcium silicate and monoclinic ZrO_2, with TiO_2 a ternary compound of the $ZrO_2 \cdot CaO \cdot 2TiO_2$ type, and with Al_2O_3 calcium aluminate and the solid solution ZrO_2–CaO. With ZrO_2 and TiO_2, a portion of the $CaZrO_3$ remains unchanged. $CaZrO_3$ does not interact with ThO_2 in equivalent mixtures, even when fired to 1600°C. (OTS)

10575 THEORY OF IMPURITY RESISTANCE IN METALS. [PART] II. J. S. Langer (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 124: 1003-10(Nov. 15, 1961).

The many-body theory of impurity resistance is extended to include all corrections resulting from electron-electron interactions. The model used is a normal Fermi fluid in the presence of a small but finite concentration of randomly scattered, fixed impurities. The resulting expression for the conductivity may be interpreted in terms of independent single-electron-like excitations, or "quasi-particles." The combined effect of the impurities and the many-body interactions causes these quasi-particles to carry current at their group velocity; but there is no effective charge correction. (auth)

10576 THE MAGNETIC SUSCEPTIBILITIES OF SOME TRANSITION METAL ALLOYS AND THE CORRESPONDING DENSITY OF STATES CURVES. S. Taniguchi, R. S. Tebble, and D. E. G. Williams (The University, Sheffield, Eng.). Proc. Roy. Soc. (London), A265: 502-18(Feb. 6, 1962).

The paramagnetic susceptibilities of bcc transition metal alloys, Ti + V, V + Cr, Cr + Mn (up to 50% Mn), Zr + Nb, Nb + Mo, Hf + Ta, Ta + W, Ta + Re (up to 37.5% Re), and Nb + Ta, were measured in the temperature range 20 to 1350°C. The observed curve of the susceptibility, χ, against composition (number of d + s electrons, q) was found to be binodal and similar for the first, second, and third series transition metal alloys. The susceptibility is a maximum for $q \sim 5$ and a minimum at slightly less than 6. The temperature dependence of susceptibility for all the alloys measured is as expected from the band model on the assumption that the shape of the density of states curve follows the (χ–q) curve. The paramagnetic susceptibility and its temperature dependence for the close-packed hexagonal phase was found to be quite different from that of the bcc phase of the same composition; from the present measurements on hcp alloys together with available data for pure metals a possible shape for the density of states curve of the close-packed structure is also proposed. These proposals are discussed in relation to the density of states curves derived theoretically by others. (auth)

10577 STUDIES ON URANIUM CARBIDES. II. X-RAY ANALYSIS OF URANIUM CARBIDES. Tetsuzo Atoda, Iwami Higashi, Yasuo Takahashi, Yoshihiko Sasa, and Masayoshi Kobayashi. Sci. Papers Inst. Phys. Chem. Research (Tokyo). 55: 217-23(Dec. 1961). (In English)

Two crystals corresponding to well-established cubic UC and tetragonal UC_2 are identified in uranium carbides prepared by carbothermic reduction of uranouranic oxide in argon atmosphere or in vacuum. Metallographic examinations also reveal the two crystals. Lattice constant of the cubic crystal is $a_0 = 4.960 \pm 0.0002$, and of the tetragonal crystal, $a_0 = 3.52$, $c_0 = 5.99$, in Å. For the two crystals in uranium carbides of known amount of combined carbon, quantitative integrated intensities of 2.87 Å line of the cubic crystal and 3.05 and 3.00 Å lines of the tetragonal crystals are respectively measured relative to intensity of 3.16 Å line of UO_2 as internal standard by automatic-recording technique, and the relative intensities are plotted against stoichiometric UC and UC_2 in weight fractions which are calculated by equations on additive relation between amounts of the carbides and combined carbon. Two straight lines obtained intersect with abscissas representing weight fractions at the points apart from origins of respective coordinates. Based on compositions corresponding to the intersecting points, it is presumed that the crystals prepared are cubic uranium monocarbide and tetragonal dicarbide, $UC_{0.92}$ and $UC_{1.91}$, which are deficient in carbon. Calibration cirves for x-ray analyses of the carbides can be obtained by drawing straight lines from origins of respective coordinates parallel to the straight calibration lines for stoichiometric UC and UC_2. (auth)

10578 PHASE RELATIONSHIPS IN THE NICKEL–ZIRCONIUM AND THE NICKEL–HAFNIUM ALLOY SYSTEMS. M. E. Kirkpartick and W. L. Larsen (Ames Lab., Ames, Iowa). Trans. Am. Soc. Metals, 54: 580-90 (Sept. 1961). (IS-280)

The phase diagram for the nickel–zirconium alloy system was established through solidus and liquidus temperature determinations, temperature vs resistance measurements, metallographic examinations, and x-ray diffraction investigations. The intermediate phases $Ni_{11}Zr_9$, $Ni_{10}Zr_7$, Ni_5Zr_2, and Ni_5Zr are formed peritectically at 1170°C (2138°F), 1160°C (2120°F), 1180°C (2156°F), and 1300°C (2372°F), respectively. The phases $NiZr_2$, NiZr, and Ni_7Zr_2 melt congruently at 1110°C (2030°F), 1240°C (2264°F), and 1410°C (2570°F), respectively. Crystallographic data for several of these intermediate phases are also presented. The intermediate phases which form in the nickel–hafnium system are equivalent to the corresponding nickel–

zirconium phases in that their compositions, modes of formation and crystal structures are analogous. (auth)

10579 THE CONSTITUTION DIAGRAM TUNGSTEN–HAFNIUM. Bill C. Giessen, Irmgard Rump, and Nicholas J. Grant (Massachusetts Inst. of Tech., Cambridge). Trans. Met. Soc. AIME, 224: 60-4(Feb. 1962).

The system W–Hf was determined by use of metallographic and x-ray methods. The only intermetallic phase W_2Hf melts peritectically at 2650 ± 50°C. A eutectic between W_2Hf and β-Hf solid solution exists at 78 at.% Hf and 1930 ± 10°C. The addition of tungsten lowers the hafnium transformation; there is a eutectoid at 93 at.% Hf and 1560°C. The solubility limits of the terminal solid solutions were determined. (auth)

10580 SHEAR TEXTURES IN COPPER, BRASS, ALUMINUM, IRON, AND ZIRCONIUM. Robin O. Williams (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 224: 129-40(Feb. 1962).

The textures which are produced by simple shear in polycrystalline samples of copper, brass, aluminum, iron, and zirconium were determined. For the fcc materials, there are two major textures, both of which are oriented for slip on the usual slip systems. It is shown that each grain will, in general, give rise to both orientations through the production of deformation bands. This is considered a clear demonstration that such bands are produced by the heterogeneous deformation which takes place instead of the five-slip-system model. The results on iron and zirconium are more limited but would appear to exhibit certain additional complexities. It is suspected, however, that the general consideration of deformation bands may apply here also. Some correlation was found between the textures produced by this single shear and the conventional textures although it would appear that additional data and analysis are required to produce a strong correlation. (auth)

10581 A STATISTICAL APPROACH TO EQUILIBRIUM DIAGRAMS. L. F. Mondolfo (Illinois Inst. of Tech., Chicago). Trans. Met. Soc. AIME, 224: 164-80(Feb. 1962).

An investigation of the relation between properties of the elements and type of binary diagram formed was conducted. It was found that, for each type of equilibrium diagram, the factors for the size, valence, electronegativity, period, melting point, entropies of fusion, and sublimation calculated for each pair of elements cover a range of values. However, these factors show sufficient relation to the equilibrium diagram so that the correlation of several of them can be used to predict the type of diagram formed, or at least limit the choice to only a few types. (auth)

10582 THE SOLUBILITY OF NIOBIUM (COLUMBIUM) NITRIDE IN GAMMA IRON. Rodney P. Smith (U. S. Steel Corp., Monroeville, Penna.). Trans. Met. Soc. AIME, 224: 190-1(Feb. 1962).

The solubility of niobium nitride in γ iron was determined for the temperature range 1191 to 1336°C from the nitrogen content and metallographic examination of a series of Fe–Nb alloys. A time series at 1200°C using samples of highest niobium content indicated that one day was sufficient for equilibrium. The change in nitrogen content with alloy content for a number of systems was practically the same for the liquid alloy at a temperature near 1600°C as for the solid alloy at temperatures near 1200°C when the alloy content is below a few percent. The x-ray diffraction pattern of the extracted nitride indicated that the composition of the nitride was between NbN and $NbN_{0.9}$. A molal heat of solution of NbN in γ iron was found to be 46800 cal. Data are tabulated. (P.C.H.)

10583 THE IMPACT PROPERTIES OF UNALLOYED PLUTONIUM. H. R. Gardner (General Electric Co., Richland, Wash.). Trans. Met. Soc. AIME, 224: 200-1 (Feb. 1962). (HW-SA-2293)

The effect of temperature on the unnotched and notched Charpy impact properties of Pu was studied in the α, β, γ, and δ phases encompassing a temperature range of −45 to 330°C. For unnotched specimens impact energies generally increased with increasing test temperature in the α and β phases. Brittle failures were obtained in these phases. The specimens tested in the γ phase did not fracture but bent in a U-shape and pulled through the anvil. Impact energies for the Charpy V-notched specimens were much lower than for the unnotched specimens at corresponding temperatures. Brittle failures were obtained in the α and β phases; some ductility was evidenced in the γ phase, while the specimen tested in the δ phase did not fracture but bent in a U-shape. It was concluded that the β phase is quite sensitive to both strain rate and notch effects. Fracture appearance in the α and β phases is discussed from the standpoint of grain boundary effects and microcracking. (auth)

10584 THE SOLUTE METALLIC VALENCE AS AN INDEX OF PHASE STABILIZATION IN ZIRCONIUM-BASE ALLOYS. J. C. Uy and A. A. Burr (Rennsselaer Polytechnic Inst., Troy, N. Y.). Trans. Met. Soc. AIME, 224: 204(Feb. 1962).

Discussion is given on valences derived by Pauling for elements as they are bonded in the solid metallic state. Data on the relation between the Pauling metallic valence of the solute and the stabilization of allotropic phases in zirconium are tabulated. Evidence is cited for allotropic transformation when a change in structure occurs as a result of the change in the energies of the bonding electrons. Since the Pauling valence is the number of bonding electrons per atom, and these are the only electrons whose energies are affected by thermal excitation, it is inferred that the introduction of a solute which has a higher Pauling valence than that of the solvent raises the initial Fermi level; consequently, the transformation temperature is lowered. The converse is also true. (P.C.H.)

10585 MAGNETIC PROPERTIES OF THE RARE EARTH METALS PRASEODYMIUM AND SAMARIUM AT LOW TEMPERATURES. Peter Graf (Technische Hochschule, Munich and Institut für Tieftemperaturforschung der Bayerischen Akademie der Wissenschaften, Herrsching, Ger.). Z. angew Phys., 13: 534-8(Nov. 1961). (In German)

The magnetic properties of compact praseodymium and samarium metals were investigated. The compact praseodymium metal was paramagnetic up to 1.5°K in the same way as Leipfinger found for the metal powder. In contrast to the metal powder, the effect of the crystal field on the deviations from the Curie law was shown for the compact metal at low temperatures, which is valid at higher temperatures for the compact metal. The magnetization curve and paramagnetism of Sm metal under 155°K are discussed. The residual magnetization was dependent on the preliminary treatment of the samples and the research conditions. It is not a property of the pure metal. It appears to be dependent on the presence of nitrogen in the samarium metal. The susceptibility curve has a Neel point. It does not agree with the values measured by Leipfinger on the metal powder. (tr-auth)

10586 INVESTIGATIONS ON THE TIME-RUPTURE BEHAVIOR OF ALUMINUM–MAGNESIUM ALLOYS. Karl Ernst Mann. Z. Metallk., 52: 607-11(Oct. 1961). (In German)

The high-strength alloy Al–Zn–Mg–Cu 0.5 is insensitive to continued loading at room temperature. At 100 and 150°C however a distinct drop of the time-rupture strength occurs which is characteristic also for other high-strength aluminum alloys. This drop may be connected to over-aging phenomena. The results, according to E. J. Dorn, could approximately be graphically represented, whereby the temperature dependence of the time-rupture strength may be extrapolated for the different length of times. (auth)

10587 A METHOD FOR THE DETERMINATION OF THE HOT DEFORMABILITY OF ALUMINUM–MAGNESIUM ALLOYS. Horst Gravemann. Z. Metallk., 52: 611-14 (Oct. 1961). (In German)

The plasticity of metals at elevated temperatures and at high deformation rates was studied by the hot impact tensile test. It is shown in the case of Al–Mg alloys containing 4.4% by weight Mg that there exists a relation between the curves for the reduction of area in hot impact tensile tests and the behavior during wire-rod rolling. The hot impact tensile test also served for investigations of the effect of Na impurities on the plasticity of these alloys at elevated temperatures. (auth)

10588 METAL STRUCTURE AND BRIGHTNESS OF THE SURFACE OF PURE ALUMINUM AND ITS ALLOYS. Hans Ginsberg and Heinrich Neunzig (Vereinigte Aluminium-Werke A. G., Bonn). Z. Metallk., 52: 626-31(Oct. 1961). (In German)

Investigations show that the surface brightness of Al–Mg alloys based on Al 99.9H depends primarily on the cast structure. This structure is, however, favored by a homogeneous globular cast structure, which remains fine-grained even after a homogenizing treatment of 8 to 10 hours. The right forging temperature is also of great influence on a structure-free surface. Homogenized rolling ingots have to be cold rolled before they are heated to hot-rolling temperatures of 520 to 530°C. Thus a complete recrystallization of the hot rolling plate is ensured. Lengthy tempering in a temperature range of 350 to 450°C has to be avoided because this leads to a reprecipitation of structural constituents which were dissolved during the homogenizing treatment. The soft annealing may be carried out as well in a sheet stack at temperatures of 320 to 340°C (annealing time 2 to 3 hours) as in a conveyor furnace at 450 to 500°C in a short time. The cold-rolling of the ingot can even be neglected in the latter case. A recrystallization treatment is, in any case, necessary before the annealing of the semi-hard state (several hours at 220 to 240°C) or before the final thickness is reached. These instructions may enable one to obtain the shining effect with magnesium alloys based on Al 99.9H that could be compared favorably to that of "Reflectal". (auth)

10589 EFFECTS OF FEATHER CRYSTALS IN THE MACROSTRUCTURE ON EARING BEHAVIOR AND ELOXAL STRUCTURE OF SHEETS OF PURE ALUMINUM. Hans Zeiger (Wieland-Werke A. G., Ulm, Ger.). Z. Metallk., 52: 632-5(Oct. 1961). (In German)

The as-cast structure of d.c.-cast aluminum ingots sometimes shows feather-like crystals. The influence of this type of crystals on the earing behavior and on the surface markings after anodizing was investigated on Al 99.5-sheets of 2 mm thickness. Feather-like crystals gave rise to more irregular and higher earings in all cases. Hot and afterwards cold rolled sheets showed markings on the anodized surface, which were intensified by feather-like crystals in the ingot. Extruding prior to hot rolling suppressed these markings completely, but did not affect the earing behavior. (auth)

10590 THE EFFECT OF INGOT STRUCTURE ON THE EARING BEHAVIOR OF ALUMINUM. J. C. Blade. Z. Metallk., 52: 636-44(Oct. 1961). (In German)

It was shown that the initial ingot texture has a marked influence on the earing behavior of super-purity and commercial-purity aluminum. In both as-rolled and annealed sheet the most significant factor was the angle between the $\langle 100 \rangle$ fiber axis and the transverse direction. A large 90° earing factor was observed if the fiber axis was either parallel to or in a plane perpendicular to the transverse direction. The increased 45° earing in the as-rolled sheet was associated with rotation of the "R" texture components toward a $\{112\}\{111\}$ type of texture or with lack of symmetry in the texture, i.e. more of one pair of complementary "R" components than the other. Less cube texture was formed in the annealed sheet when the components of the "R" texture in the as-rolled sheet were rotated significantly from their ideal positions. It is shown that the results obtained from the work on directionally solidified ingots can be used to predict the changes in earing that can occur as a result of varying the rolling direction for direct-chill cast ingots with different sump contours. (auth)

10591 SURVEY ON THE POWDER METALLURGY OF ALUMINUM. John G. Solomir (Aluminium-Industrie A. G., Neuhausen, Switzerland). Z. Metallk., 52: 645-51(Oct. 1961). (In German)

In the years since the discovery of dispersion-strengthened aluminum alloys there has been much progress in both the theoretical and the practical field. Although the mechanical strength of the first S.A.P. materials was not surpassed by much, the improved understanding of the different processes involved permitted the development of more ductile, easier to fabricate materials. Lately newer and higher demands as to homogeneity and thermal stability of the S.A.P. structure have been put forward, mainly by reactor construction people. The further development of S.A.P. is going toward making a material which is able to meet the highest specifications. (auth)

10592 ORIENTATION OF PRIMARY RECRYSTALLIZED GRAINS IN STRESSED SINGLE CRYSTALS OF PURE ALUMINUM. Frank Haessner (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 52: 651-9(Oct. 1961). (In German)

The orientation of newly formed grains during the recrystallization of strained aluminum single crystals was determined. A quantitative analysis of the orientation distribution leads to the following result. Spontaneously nucleated grains which are surrounded by a deformed matrix, show an irregular orientation distribution upon which an orientation component is superimposed, which can be related to the matrix by a rotation of ±28° (more seldom ±40°) around a $\langle 1\bar{1}1 \rangle$ axis. A weaker orientation component can also be related to the matrix by a rotation of ±28° around one of the left three $\langle 1\bar{1}1 \rangle$ axis. Artificially nucleated grains show an orientation which borders on a deformed matrix at one side and can be related to the matrix by a rotation of ±28°, ±37°, or ±40° around the $\langle 1\bar{1}1 \rangle$ axis. The preference of a specific $\langle 1\bar{1}1 \rangle$ axis and the distribution depend on the orientation of the wire axis. It can be concluded from the test results that grains with a spontaneous nucleation having the 28° and 40° $\langle 1\bar{1}1 \rangle$ texture component originated from oriented nucleation. In a supplement, a mathematical derivation

of the orientation analysis of cubic-symmetrical crystals with random orientation is given. (auth)

10593 LATTICE EXPANSION IN PUREST ALUMINUM AFTER PLASTIC DEFORMATION. Hans Christian and Eckard Macherauch (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 52: 660-7(Oct. 1961). (In German)

This is a presentation of a survey of the investigations made on the relative volume and density changes of deformed metals. The x-ray measurements in connection with the lattice expansion of plastically deformed aluminum are discussed, and it is shown that the observed lattice changes might have been caused by residual stresses due to plastic deformation. It was not possible to determine the lattice expansion of strained polycrystalline samples by conventional x-ray methods. A precise method for determining the lattice changes of cold worked samples is given, however, by the existence of strain-free directions. The x-ray method and its fundamental principles for the determination of the lattice expansion of any type of strained samples is described. Some measurements carried out with rolled pure aluminum show that above a degree of rolling of nearly 12% lattice expansions could be confirmed and increase with higher deformation. At higher degrees of rolling relative parameters of $\sim +1 \cdot 10^{-4}$ were observed. The possibility of using the described method to determine the density of dislocations in deformed aluminum is pointed out. (auth)

10594 X-RAY STUDY ON THE OCCURRENCE OF STACKING IN VARIOUS ALUMINUM ALLOYS. Hugo Josef Seemann and Fritz Stavenow (Universität, Saar, Saarbrücken, Ger.). Z. Metallk., 52: 667-70(Oct. 1961). (In German)

X-ray measurements have shown that in pure aluminum no deformation stacking faults occur after cold working. In the systems Al–Mg, Al–Zn, and Al–Mg–Zn, however, this effect could be detected at small alloying additions. The stacking fault density in these binary systems increases with increasing content of Mg and Zn. The system Al–Zn shows a distinct maximum of the stacking fault probability. In cold-worked Al–Cu alloys no stacking faults could be found. (auth)

10595 SEGREGATION PROCESSES IN THE ALUMINUM–SILVER SYSTEM. Reinhold Baur and Volkmar Gerold (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 52: 671-6(Oct. 1961). (In German)

Quantitative measurements of the small angle x-ray scattering have given some new results on the kinetics of segregation (formation of G.P. zones) in binary aluminum–silver alloys. The spherical zones are already forming during quenching from the homogenization temperature. In aging some minutes at room temperature a state of total segregation is reached in which the whole alloy consists of silver-rich zones surrounded by silver-poor regions. The silver concentrations are given by a metastable micsibility gap with a critical point at a temperature of about 450°C. When the aging temperature is changed, the silver concentrations inside and outside the zones change quickly to new values. This process is followed by a slow growth process, during which the number of zones N_z is reduced and the size of the zones is increased, the radius R_1 growing from 10 to 70 Å. The growth process was investigated in the range from 23 to 300°C. For all three alloys (6 to 12 at. % Ag) the following rate law was found: $R_1^4 - R_{10}^4 = k(t - t_0)$. The temperature dependence of the rate constant k gives a single activation energy of 22.5 kcal/mole. In comparing the growth of the zones in the three alloys, it was found that for various aging temperatures and times the number of zones N_z in different alloys is the same. (auth)

10596 THE ANNEALING OF THERMALLY PRODUCED VACANCIES IN ALUMINUM. Klaus Detert and Ingrid Staender (Technische Universität, Berlin). Z. Metallk., 52: 677-81(Oct. 1961). (In German)

Previous measurements of the formation of vacancies were confirmed by studies of the change in resistance and in length of aluminum wire caused by thermally developed vacancies. In addition to the known value for the heat of formation of vacancies the entropy factor was determined. Electrical resistance studies of vacancy annealing were in good agreement with previous results. Change in length measurements however, necessitated a correction of the known data. The annealing of single and bi-vacancies occurred in a much shorter time than expected. This process took place mainly during the initial processes of the change in resistance, which previously were disregarded in kinetic investigations. The annealing of vacancies was more evident during the change in length. The slower annealing during the change in resistance was due to the annealing of ring-dislocations which were caused by clusters formed from agglomerating vacancies. (auth)

10597 THE SOLUBILITY OF HYDROGEN IN SOLID AND LIQUID ALUMINUM. Walter Eichenauer, Karl Hattenbach, and Alfred Pebler (Technische Hochschule, Darmstadt, Ger.). Z. Metallk., 52: 682-4(Oct. 1961). (In German)

The hydrogen absorption of pure aluminum between 360 and 1050°C was calculated from the temporal process of degassing. The following relation stands for solid aluminum: $\log l = 0.521 - (3042/T) + \frac{1}{2} \log p$ (l in cm^3NTP/100 g, p in Torr, T in °K). The corresponding formula for liquid aluminum is: $\log l + 1.529 - (3086/T) + \frac{1}{2} \log p$. The square root law is satisfied within the limit of error in the solid and in the liquid state. Diffusion in the metal is responsible for the hydrogen-degassing rate of the solid aluminum. The diffusion coefficient is $D = 0.11 \exp(-9780/RT) cm^2/s$. A reaction of first order, atomic hydrogen being present, is responsible for the degassing rate in the liquid state. (auth)

10598 EFFECT OF COLD PRE-AGING ON THE PATTERN OF DISPERSION HARDENING. Heinz Borchers and Max Kainz (Technische Hochschule, Munich). Z. Metallk., 52: 685-92(Oct. 1961). (In German)

Available literature on this topic had discussed how pre-aging within a temperature-range of –195 to 30°C affects the succeeding dispersion hardening of Al–Zn–Mg, iron–carbon alloys, iron–nitrogen alloys, Pb–Sb, and Al–Mg–Si. The dispersion hardening tests on Al–Mg–Si included hardness determinations after quenching from various temperatures and after pre-aging at temperatures between –50 and +20°C. A short pre-aging at room temperature and at lower temperatures accelerated and intensified the aging process at elevated temperatures. The aging at elevated temperatures was retarded, however, by lengthy pre-aging at room temperature. The primary reactions at low temperatures could be followed by means of electrical resistance measurements. The results obtained cause the question of a probable direct or indirect sequence that may exist between the cold and warm dispersion hardening states to arise. (auth)

10599 THE SYSTEM UAl_2–U_3Si_2. Gunter Petzow and Ingard Kvernes (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 52: 693-5(Oct. 1961). (In German)

The equilibrium relation between UAl_2 and U_3Si_2 was investigated by a combination of thermal, microscopic, x-ray, and temperature-temperature difference measurements. These intermetallic phases are components of a simple eutectic system with the eutectic point lying at 26 at. % Si and 1360°C. A complete miscibility gap is found at 850°C. The solubilities of Si in UAl_2 and of Al in U_3Si_2 are similar and amount to 1 at. % at the eutectic temperature. (auth)

10600 PRECIPITATION IN β TITANIUM–VANADIUM ALLOYS. Otto Krisement (Max-Planck-Institut fllr Eisenforschung, Dusseldorf). Z. Metallk., 52: 695-704(Oct. 1961). (In German)

The tempering of β Ti–V alloys occurs in two steps. Cold hardening is observed from room temperature up to 400°C, and above 400°C the precipitation of the hexagonal α equilibrium phase occurs simultaneously with cold hardening. To compare microcalorimetric measurements of the precipitation processes with thermodynamic data, the heat of mixing of β alloys was calculated from the (α + β) phase boundaries. A positive heat of mixing is found, thus indicating the existence of a mixing gap which has not yet been observed experimentally. For the investigated alloys with 14.7 to 19.1 at. % V, the upper temperature limit for cold hardening was found to be $T_K = 475°C$. This temperature is very probably determined by the position of the spinodal curve. In the cold hardening region the appearance of the metastable ω phase is observed, which could be proved with the neutron diffraction pattern. The isothermal kinetics of cold hardening, measured with the heat release $\dot{Q}(t)$ per unit of time, is governed by a hyperbolic law, and the total amounts of heat given off are very close to those which are to be expected when the alloy is decomposed according to the calculated mixing gap. The diffusion process acting during cold hardening could not be analyzed: its activation energy must be significantly smaller than the activation energy of the chemical diffusion coefficient for titanium and vanadium, though not much excess quenched-in vacancies could be present. The latter activation energy was determined from the temperature dependence of the α phase precipitation in the second tempering stage which gave the value A = 55,000 cal/mole. D_0 was found to be approximately 5 cm^2/sec. The α phase is precipitated by nucleation and diffusion-controlled growth, and nucleation occurs very probably in a homogeneous manner. The heat given off during precipitation is about the same as calculated from the decomposition of the initial β crystals in domains of different vanadium content given by the (α + β) boundaries, the heat of β – α transformation thus being small in the temperature range from 400 to 450°C in comparison to the heat of mixing of the β alloys. (auth)

10601 THE INTERMEDIATE H PHASE IN THE AGE-HARDENING OF COPPER–BERYLLIUM ALLOYS. Hans Thomas (Laboratorium der Vacuumschmelze A. G., Hanau, Ger.). Z. Metallk., 52: 750-3(Nov. 1961). (In German)

The age hardening of copper–beryllium alloys takes place in three stages: Guinier-Preston zones, γ′-phase, and γ-phase. The degree of the formation and the amount of these single stages can be determined by the changes of the electrical resistance caused by cold working of aged samples. If Guinier-Preston zones are present, the resistance is first slightly increased by cold working and afterwards a little lowered nearly to the value of non-aged samples which have the same degree of cold working. The superlattice of the intermediate γ′ phase is sensitive to cold working similar to other superlattices. If considerable amounts of γ′ were formed during aging the resistance is strongly raised by deformation, eventually even to the value of nonaged samples. In case of decomposition into α + γ during aging, only a relative slight increase of the resistance occurs due to deformation. Thus it may be shown that the increase of hardness during aging is mainly due to the formation of the intermediate γ′ phase and that according to previous results the uniformity and stability of γ′ actually can be improved by small additions of nickel, cobalt, or dissolved iron. (auth)

10602 DIFFUSION OF TRI- AND TETRA-VALENT FISSION PRODUCT IONS IN UO_2. F. Schmitz and R. Lindner (Chalmers Tekniska Högskola, Göteborg). Z. Naturforsch., 16a: 1096-7(Oct. 1961). (In German)

The measurement of the diffusion of Y^{91}, Pm^{147}, and Zr^{95} in the temperature range from 1120 to 1450°C is described. The results obtained for the lattice diffusion of the fission products in UO_2 sinter tablets and the activation energy of the diffusion are tabulated. These results show that the diffusion coefficients and activation energies obtained are comparable with the values obtained for fission gases and that the activation energies increases with the ion radius and ion charge. (J.S.R.)

10603 STRUCTURE OF Hf–Be COMPOUNDS. P. I. Kripyakevich, M. A. Tylkina, and E. M. Savitskii. Zhur. Strukt. Khim., 2: 424-33(July-Aug. 1961).

A series of Hf–Be alloys with an Hf content from 0.05 to 95.5% were studied by x-ray diffraction, microscopic examination, and microhardness measurements. The alloys were melted from iodide Hf and 99.3% pure Be. Four compounds were found: $HfBe_2$, $HfBe_5$, Hf_2Be_{17}, and $HfBe_{13}$. These compounds proved to be of the same type structurally as the respective compounds of the Zr–Be system. $HfBe_2$, $HfBe_5$, and $HfBe_{13}$ have the same structure as the respective Zr compounds; Hf_2Be_{17} has a structure of related type. In all cases the lattice parameters of the Hf–Be compounds are smaller than those of the Zr compounds. An increase in the Be content of the Hf–Be compounds decreases the distance between the Be atoms ($HfBe_2$, 2.179; $HfBe_5$, 2.17; Hf_2Be_{17}, 2.14; and $HfBe_{13}$, 2.07) and increases the distance between the Hf atoms. $HfBe_2$ has an $AlBe_2$-type lattice; $HfBe_5$ has a $CaZn_5$-type lattice; Hf_2Be_{17} has a U_2Zn_{17}-type lattice; and $HfBe_{13}$ has a $NaZn_{13}$-type lattice. (OTS)

Radiation Effects

Refer also to abstracts 10229 and 10230

10604 (APEX-671) THE EFFECTS OF REACTOR FLUX ON THE SLIDING CHARACTERISTICS OF HIGH TEMPERATURE MATERIALS. R. E. Lee, Jr. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 44p.

The results indicated that integrated dosages of the order of 1.6×10^{19} nvt at 800 or 1200°F did not have any significant effects on the sliding characteristics of the materials examined. The following material pairs showed the most acceptable sliding behavior over a broad temperature range: 56HT Graphite vs Inconel X; M2 Tool Steel vs M2 Tool Steel; Malcomized 304 Stainless Steel vs Malcomized 304 Stainless Steel; Stellite 25 vs Malcomized 304 Stainless Steel. (auth)

10605 (APEX-676) RADIATION EFFECTS ON THE STRESS RUPTURE PROPERTIES OF INCONEL X AND

A-286. C. G. Collins, G. L. Hammons, F. C. Robertshaw, and W. H. Couts (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 44p.

Results are presented of stress-rupture measurements on Inconel X and A-286 performed following irradiations at ~140°F and at 1000 to 1200°F. The 100 hour rupture strength of Inconel X was decreased ~50,000 psi at 1200°F and that of A-286 was decreased ~40,000 psi at 1200°F and ~20,000 psi at 1000°F. Both alloys appeared notch-sensitive and exhibited brittle fractures following irradiation. These property changes occurred at a dosage of 3×10^{18} n/cm^2 ($E_n \geq 1$ Mev), the lowest dosage investigated. The radiation induced changes appeared to be influenced significantly by irradiation temperature and were more pronounced in elevated temperature irradiations. Post-irradiation thermal annealing at temperatures up to 1200°F of specimens irradiated at 140°F did not appreciably influence the changes. It seemed reasonably clear that the property changes were not due to simple growth or re-solution of the precipitate particles. (auth)

10606 (DC-55-5-90) SURVEY AND EVALUATION REPORT ON RADIATION DAMAGE TO PLASTIC MATERIALS. C. G. Collins, W. J. Stapp, and V. P. Calkins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 13, 1955. Contract AT(11-1)-171. 113p.

A compilation of data on radiation damage to plastic materials is presented for use as a guide in the selection of materials to be used in radiation fields. Radiation damage to the plastics consists of changes in the physical and electrical properties and in the evolution of gases; dosages to cause significant changes in the various materials range from 10^5 to nearly 10^{10} rads. Quantitative data on the property changes in thirty-eight commercial plastics are presented in tabular and graphical form with dosages expressed in energy units. These data can be used together with the equivalent particle dosages listed to estimate the useful life of a plastic material in a given radiation field. (auth)

10607 (DC-55-6-101) SURVEY AND EVALUATION REPORT ON RADIATION DAMAGE TO CERAMIC MATERIALS. C. G. Collins, W. J. Stapp, and V. P. Calkins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 16, 1955. Contract AT(11-1)-171. 24p.

A compilation of data is presented on radiation damage to ceramic materials and is presented for use as a guide in the selection of materials to be used in radiation fields. Radiation damage to ceramic materials consists of changes in the physical and electrical properties which are due primarily to the dislocation of atoms by fast neutrons. It appears that dosages of 10^{18} to 10^{19} fast neutrons/cm^2 cause physical property changes of the order of 5%, and that dosages of 10^{16} or higher cause increases in electrical conductivity by a factor of 10 to 100. Most ceramic materials should perform satisfactorily in applications outside the aircraft reactor shield since dosages are not expected to exceed 5×10^{16} fast neutrons/cm^2 for 1000 hours of operation. Materials which should not be used for electrical purposes include the glasses and semi-conductors. (auth)

10608 (DC 57-11-718) TEST OPERATING REPORT: GE-ANP-2SM2 SPECIAL MATERIALS TEST IN THE MTR. T. D. Price (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 22, 1957. Contract AT(11-1)-171. 27p.

The operating history of the first unclad hydrided zirconium sample to be tested in the MTR is presented. The test operated for the requested 100 hours at a maximum temperature of 1120°F. Thermocouple loss was high, but this was expected, due to the poor quality of the platinum wire that was used. Filtered samples of the discharge coolant were taken at the start and end of the test and analyzed for zirconium. No zirconium was detected. Visual post-irradiation inspection revealed several cracks in the hottest quadrant number 4 and the adjacent quadrant number 3. (auth)

10609 (DC-58-5-179) RADIATION EFFECTS ON ELECTRONIC EQUIPMENT. John R. Crittenden (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 23, 1958. Contract AT(11-1)-171. 23p.

The possible mechanisms for radiation damage in electronic equipment are discussed along with the shielding problem, and the measurement problem. Two experiments are described to illustrate possible results. (auth)

10610 (DC-59-10-185) THE RADIATION TESTING OF A FUEL ELEMENT–TEST LVC-2. R. E. Blevins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 16, 1959. Contract AT(11-1)-171. 14p.

Radiation testing of a ceramic fuel element to measure fission product diffusion through high density Al_2O_3 coating is described. The test assembly was exposed to a dosage of approximately 1.3×10^{17} nvt. Data on the ceramic element and operation of the LITR during the test are included. It is noted that the sample was shipped to another facility for further analysis. (J.R.D.)

10611 (DC-59-11-5) THE RADIATION-OXIDATION TESTING OF BERYLLIUM METAL SPECIMENS: TEST LTBM-1, LTBM-2, AND LTBM-3 [1957]. R. C. Lee (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati and Oak Ridge National Lab., Tenn). Oct. 21, 1959. Contract AT(11-1)-171. 18p.

Test capsules were developed for irradiating beryllium in the LITR flux, and three tests were run on beryllium bar stock at 1200°F. No results aside from pre-irradiation measurements and irradiation history are given. (D.L.C.)

10612 (DC-59-11-160) THE RADIATION TESTING OF A FUEL ELEMENT WITH SPECIAL THERMOCOUPLE ATTACHMENTS, LTTC-1. Jack D. Elkins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 16, 1959. Contract AT(11-1)-171. 41p.

Test LTTC-1 was conducted in Hole C-48 of the LITR to study the different methods and hardware of attaching Pt-Pt–10% Rd thermocouples to a metallic fuel specimen. The test assembly was inserted on April 21, 1959, and the test operated until the normal weekly shutdown of the LITR on April 27, 1959. (auth)

10613 (DC-59-11-196) A REPORT OF THE IN-PILE TESTING OF TWELVE BOURNS TRIMPOTS–XCI-42. H. C. Colley (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 11, 1959. Contract AT(11-1)-171. 33p.

An in-pile test was conducted in the ORNL Graphite Reactor to determine the effects of 1 g vibration and radiation on the resistance of 12 trimpots, initially 5×10^5 ohms ± 20%. No major change in the trimpot resistance was noted until the first weekly reactor shutdown after 148 hr operation (total dosage ~4.7×10^{17} nvt), when 8 of the trimpots appeared to have opened at the wiper arm contact. The test was terminated after 1178 hr reactor operation (total dosage ~3.8×10^{18} nvt) with none of the trimpots operational. (D.L.C.)

10614 (DC-60-3-244) COMBINED RADIATION TEMPERATURE EFFECTS ON SILICONE RUBBERS AND TEFLON, MILESTONE 51444-5. C. G. Collins (General Electric

Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 31, 1960. Contract AT(11-1)-171. 28p.

Experimental measurements of combined radiation-temperature effects are reported on silicone rubbers and Teflon in work directed toward defining the radiation limitations of high temperature, flexible, moisture-proof electrical insulations. The work reported included screening tests on a number of silicone rubber cable materials utilized in jet engines, comparative tests on the three more stable materials and measurements of the tensile strength and elongation of SE-555, the elastomer which appeared most stable. Results on SE-555 are summarized in graphs showing time-temperature-radiation and dose-dose rate conditions corresponding to a stated amount of property change. Emphasis was placed on physical integrity rather than electrical properties since resistivity changes were undetectable after exposures at which the physical properties were severely changed. (auth)

10615 (DC-60-4-84) SUMMARY REPORT: MTR TEST 1T1. C. L. Miller (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 13, 1960. Contract AT(11-1)-171. 17p.

1T1, a six-fueled-stage nichrome cartridge was operated at various temperatures for 264 hr in the MTR HT-1 facility prior to fission product release. The temperature of a small area of fuel plate was in excess of 2000°F during about half of this time. (auth)

10616 (DCL-60-1-72) POST-IRRADIATION METALLOGRAPHIC ANALYSIS OF MTR-GEANP-1P1. W. Von Ketron (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 17, 1959. Contract AT(11-1)-171. 9p.

Data from the post-irradiation metallographic analysis of the GEANP-1P1 MTR fuel cartridge test are presented. Results of examination for effects of oxidation penetration and general irregularities such as weld burns and blisters are included. (J.R.D.)

10617 (DEG-Report-292) THE 'p' VALUE METHOD OF DETERMINING PREFERRED ORIENTATION IN URANIUM FUEL RODS, AND ITS EXTENSION TO THE PREDICTION OF IRRADIATION GROWTH. R. D. Arnell and J. Clayworth (United Kingdom Atomic Energy Authority. Development and Engineering Group, Culcheth, Lancs, England). July 17, 1961. 20p.

A method is described for using preferred orientation data for prediction of physical properties in U fuel rods. Data from several x-ray-diffraction peaks are combined to serve as a single parameter relating texture to irradiation growth. Sources of error in the method are described and error minimization techniques are suggested. (J.R.D.)

10618 (NAA-SR-6642) FISSION DAMAGE IN METALS. J. A. Brinkman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 1, 1962. Contract AT(11-1)-GEN-8. 50p.

A model of the damage produced by the occurrence of a fission event within a metal is presented. The numbers and spatial distribution of lattice defects produced by such an event including interstitial atoms, vacant lattice sites, and displacement spikes are considered. The roles which each of these defects play in producing such phenomena as swelling, radiation-induced phase transformations, and other physical property changes in metallic reactor fuel materials, are examined. In the development of this model, the approximation is made that all fission fragments are of two kinds prior to their coming to rest. Each fission event is considered to produce one of each kind: a light fragment with a mass of 96 amu, an atomic number of 39, and an intital energy of 95 Mev; and a heavy fragment with a mass of 137 amu, an atomic number of 55, and an initial energy of 67 Mev. The interaction energy between pairs of atoms having atomic numbers Z_1 and Z_2, as a function of their inter-nuclear separation, r, is considered to be given by a new empirical atomic interaction potential

$$V(r) = 1.9 \times 10^{-6}\, Z_{eff}^{7/3}\, E_R \frac{\exp(-Z_{eff}^{1/3}\, r/1.5a_0)}{1-\exp(-0.95 \times 10^{-6}\, Z_{eff}^{2/3}\, r/a_0)}$$

where E_R represents the Rydberg energy, a_0 is the radius of the first Bohr orbit of hydrogen, and $Z_{eff} = Z_1^{1/3} Z_2^{1/3}$. (auth)

10619 (NASA-TN-D-1193) PRELIMINARY STUDY OF THE EFFECTS OF IONIZING RADIATIONS ON PROPELLANTS; THE X-IRRADIATION OF AMMONIA AND HYDRAZINE. Harold W. Lucien (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Feb. 1962. 9p.

Irradiation of ammonia vapor, liquid ammonia, and hydrazine vapor by a 250-kv, 15-ma source that provided 90 to 100 r/min resulted in decompositions varying from less than 1 to 3%. In addition to the formation of N and possibly H from the ammonia and hydrazine decompositions and the formation of hydrazine from ammonia and ammonia from hydrazine, other materials were formed that were not characterized. (auth)

10620 (NP-11370) DYNAMIC AND STATIC IRRADIATION OF NUCLEAR POWER PLANT LUBRICANTS. D. B. Cox, E. A. Oberright, and R. J. Green (Socony Mobil Oil Co., Inc., Paulsboro, N. J.). [1961]. 9p.

Paper No. 61 LC-11, presented at the ASLE/ASME Lubrication Conference, Chicago, October 17-19, 1961.

Static and dynamic test results are given which reveal the utility of some commercial mineral oil greases and a new high-temperature, radiation-resistant grease. Irradiation tests of turbine oils show that maximum expected radiation dose in current and projected power plants over a 20-year period does not change the physical properties of the oil. Oxidation stability and other properties are therefore still of most importance in turbine oil selection. Some experimental radiation-resistant fluids are discussed which have potential for fluid lubricant use where radiation resistance may be required. (D.L.C.)

10621 (ORNL-3222) IN-PILE LOOP IRRADIATION OF AQUEOUS THORIA-URANIA SLURRY AT ELEVATED TEMPERATURE. DESIGN AND IN-PILE OPERATION OF LOOP L-2-27S. H. C. Savage, E. L. Compere, J. M. Baker, V. A. DeCarlo, and A. J. Shor (Oak Ridge National Lab., Tenn.). Feb. 14, 1962. Contract W-7405-Eng-26. 69p.

An in-pile pump loop, designed to fit within horizontal beam hole HB-2 of the Low-Intensity Test Reactor (LITR), was used to circulate an aqueous thoria-urania slurry while exposed to reactor irradiation. The total loop volume was about 1600 ml, including pump and pressurizer, but the slurry was confined to the 900-ml volume of the main loop stream by means of a sintered stainless steel filter. The filter was an important feature of the loop design in that it provided a thoria-free filtrate as a purge stream to the pressurizer and pump bearings to prevent entry and accumulation of thoria in these two regions. Corrosion-test specimens of Zircaloy-2, titanium, and type 347 stainless steel were placed in the loop at three different locations for exposure to three different levels of irradiation. Duplicate sets of specimens in each position were exposed to flow

velocities of 8 and 22 fps, respectively. For the in-pile irradiation, thorium oxide containing 0.43 wt % enriched U, based on Th, was used. This thoria-urania was produced by air calcination at 1225°C of coprecipitated oxalates and had a mean particle size of 1.7 μ. A Pd catalyst was dispersed in the slurry for liquid-phase recombination of the radiolytic gas. The loop was operated in beam-hole HB-2 of the LITR from July 19 to October 19, 1960. During this period slurry was continuously circulated at 280°C for 2220 hr without incident; 1839 hr were at full reactor power (3 Mwt), at which the estimated average thermal flux over the 300-ml volume core section was 5×10^{12} neutrons/cm^2· sec. At the start of in-pile operation the loop was charged to a concentration of 979 g of Th and 3.83 g of fully enriched U per liter (at 280°C) which was reduced by sampling to 748 g of Th and 2.74 g of U per liter at the end of the irradiation period based on the assumption that no losses had occurred. Samples of slurry were withdrawn at intervals for analyses to determine the effects of radiation on the thoria-urania slurry. (auth)

10622 (VDIT-16.4) RADIATION EFFECTS ON SOLID, URANIUM-BASED NUCLEAR FUEL MATERIALS. SUPPLEMENT III. A Bibliography. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Dec. 1961. 48p.

A third supplement to the bibliography on radiation effects on solid, uranium-based nuclear fuel materials is presented containing 100 abstracts. The references are grouped under the following topics: general, metallic uranium, binary alloys, oxide (ceramics), carbide, nitride, and dispersion fuels. Author, report number, and journal indexes are included. A coordinate subject index for all parts of the bibliography appearing in 1961 is issued separately and simultaneously as VDIT-16(Ind. 61). (M.C.G.)

10623 (WAPD-255) THE RELEASE OF HELIUM FROM SLIGHTLY IRRADIATED BORON CARBIDE AND BORON CARBIDE-SILICON CARBIDE PLATES. J. C. Clayton, W. A. Bostrom, and F. C. Schrag (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1962. Contract AT-11-1-GEN-14. 21p.

The evolution of helium from slightly irradiated boron carbide and boron carbide–silicon carbide plates was measured as a function of temperature. Assuming a diffusion mechanism based on a model of the gas adsorption area of a flat plate containing a nonuniform initial distribution of helium, diffusion coefficients were calculated for the 500 to 1000°C temperature range. The data for boron carbide may be represented by the equation, $D = 1.4 \times 10^{-8}$ exp (–29,000/RT); the activation energy is 29.0 ± 3.0 kcal/mole. The rate and amount of helium released was less for the B_4C–SiC compacts. The effect of B^{10} self-shielding and surface roughness on the simple diffusion model is shown. (auth)

10624 (XDC 59-4-6) CERAMIC INSULATED MAGNET WIRE FOR HIGH TEMPERATURE–RADIATION ENVIRONMENT; DEVELOPMENT AND EVALUATION. K. W. Arnold (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 31, 1959. Contract AF 33(038)-21102. 123p.

Development and partial evaluation of a ceramic insulated magnet wire for use in high temperature (500°C) and radiation environments is described in considerable detail. The process development is traced from feasibility to pilot line production with discussions of the effects of several process variables on the wire quality. Basically, the wire is constituted of a copper conductor covered with an oxidation resistant sheath, all coated with a ceramic glaze. The partial evaluation shows the wire electrical characteristics to be somewhat inconsistent above 10 volts breakdown turn to mandrel at temperatures 400°C. Results obtained from the evaluation indicate rapid improvement was made in the process development and also indicate further evaluation is required to provide life expectancy in component use. (auth)

10625 (XDCL-60-6-710) DATA REPORT FOR THE MTR SAMPLE 3F42. F. L. Sims and G. W. Thompson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 3, 1960. Contract AT(11-1)-171. 37p.

The 3F42 sample, a single-ring fuel ribbon was tested for 551 hours 15 minutes in the ANP-3 Facility of the Materials Testing Reactor. This sample test ran from April 2, 1960 until May 9, 1960 through MTR cycles 137 and 138. The test was composed of four different phases each with a different temperature, i.e., 1800, 2100, 2300, and 2000°F. Although the sample was originally instrumented with 8 thermocouples only 4 remained operational throughout the test. During the test period the radiation monitor on the facility did increase. However this was quite negligible and there was no evidence that a fission break was present. The sample removal at the end of the test resulted in the belief that the sample possibly was covered with oil from the coolant. An early examination in the hot shop showed this to be of only minor consequence. The sample was stored in a shipping cask to await shipment to Evendale for the post-irradiation examination. (auth)

10626 THERMAL POINTS PRODUCED BY IRRADIATION IN METALS. A. Corciovei and D. Grecu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 305-23(1961). (In Rumanian)

The last atoms deplaced appertaining to a cascade generated by a primary atom deplaced by irradiation are placed in a spherical shell of radius R if the mean free path of the deplaced atoms do not exceed approximately twice the interatomic distance. The final interstitial atoms of the spherical shell heat this region to temperatures higher than the fusion temperature and from multiple thermal points, including the totality of the thermal points produced by each interstitial atom in the spherical zone. The mean free path as a function of energy is calculated. The numerical results for copper are given and compared with the results of other authors. An evaluation of R is then given. The evolution in time of a spherical multiple point is analyzed, and some comments are made on the effects in metals. (tr-auth)

10627 STUDY OF THE STRUCTURE OF THIN GOLD FOILS IRRADIATED IN A REACTOR. C. Motoc and I. Teodorescu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 335-40(1961). (In Rumanian)

Structural modifications produced by reactor irradiation of thin gold foils in oxygen and in a vacuum were investigated. The methods utilized were electron diffraction analysis, electron microscopic analysis, and metallographic microscopic analysis. It was evident that under the action of irradiation an order-disorder phenomenon is produced: polycrystalline gold is transformed into colloidal gold. No structure other than the face-centered cubic structure was detected, and no diffraction diagram corresponding to gold oxides was observed. (tr-auth)

10628 THE EFFECT OF IONIZING RADIATION ON MATTER. J. P. W. Houtman. Atoomenergie, 3: 219-25 (Nov. 1961). (In Dutch)

This review is an introduction to a number of articles in which diverse aspects of the ionizing effect of radiation on

matter are treated in more detail. In the introduction a distinction is made between the atomic effects and the macrophenomena caused by radiation. In section 2 the atomic phenomena are described for various types of radiation, dependent on the properties of the irradiated material. In section 3 the macroeffects to be clarified in the later articles are briefly introduced. (tr-auth)

10629 THE EFFECT OF NUCLEAR RADIATION ON THE PROPERTIES OF CONSTRUCTION STEEL. IV. THE EFFECTS ON THE DESIGN AND MANUFACTURE OF REACTOR PRESSURE VESSELS. P. H. J. Simonis. Atoomenergie, 3: 226-33(Nov. 1961). (In Dutch)

The review of the experimental results on the modifications induced in the properties of steel by fast neutron irradiation is continued. (J.S.R.)

10630 SOME RELATIONS BETWEEN OPTICAL AND THERMAL BLEACHING OF COLOR CENTERS IN γ-IRRADIATED KCl CRYSTALS. J. Z. Damm (Inst. of Physical Chemistry, Polish Academy of Sciences, Wrocław). Bull. acad. polon. sci. Ser. sci. chim., 9: 639-45(1961). (In English)

Results concerning both optical and thermal bleaching mechanisms in irradiated KCl crystals are presented. In thermal bleaching the R type centers are converted partially into M, then F and N centers, the latter ones vanishing quickly. The bleaching rate (both thermal and optical) follows the kinetic equation for bimolecular recombination. The optical bleaching is, however, much more efficient because it destroys considerably more centers than can be removed thermally in a bimolecular recombination process. Since the optical bleaching involves centers that may be bleached thermally plus centers which may be bleached by F light only, the extent of the bleaching is thought to depend on the contribution of thermally available electron traps. Consequently, the rate of optical bleaching does not depend on the temperature. (P.C.H.)

10631 DIFFUSION INDUCED BLEACHING OF COLOR CENTERS IN γ-IRRADIATED KCl CRYSTALS. J. Z. Damm (Inst. of Physical Chemistry, Polish Academy of Sciences, Wrocław). Bull. acad. polon. sci. Ser. sci. chim., 9: 647-50(1961). (In English)

Studies were made on the mechanism of thermally induced bleaching within the second stage in irradiated KCl crystals. It was concluded that in the second stage, which was induced by thermal energy only, the process is presumably governed by the diffusion of electron holes (V_3 centers) which recombine with the F center electrons. At room temperature the process is extremely slow compared with the rates of bimolecular optical and thermal recombinations. (P.C.H.)

10632 LIBERATION OF WIGNER ENERGY STORED IN GRAPHITE AFTER NEUTRON IRRADIATION AT 78°K. Emmanuel Bonjour, Louis Bochirol, and Louis Weil (Centre d'Études Nucléaires, Grenoble, France). Compt. rend., 254: 456-8(Jan. 15, 1962). (In French)

The spectrum of Wigner energy liberated between 78 and 500°K by polycrystalline graphite is determined, following neutron irradiation at 78°K. Peaks are found at 200, 300, 380, and 450°K. (tr-auth)

10633 ELECTRICAL PROPERTIES OF NEUTRON-IRRADIATED SINGLE $SrTiO_3$ CRYSTALS. L. K. Vodop'yanov and E. A. Konorova. Fiz. Tverd. Tela, 3: 3426-8 (Nov. 1961).

Dielectric constant ϵ, loss angle tangent δ, electrical conductivity, and optical absorption in the visible and infrared portions of the spectrum were measured in single SrTiO crystals prior to and after irradiation with a 10^{18} cm^{-2} flux of slow neutrons. Specimens 15 to 20 mm^2 in area and 0.5 mm thick were used in the experiments. It was found that at 20 to 200°C the temperature dependencies of ϵ and tan δ prior to and after irradiation coincided. An abnormal maximum of ϵ was observed in non-irradiated specimens at 470°C which, however, disappeared after irradiation. No increase in tan δ was observed in relation to increased ϵ. D-c conductivity was measured in a vacuum of $\sim 10^{-6}$ mm Hg. With increased temperature the d-c conductivity increased irreversibly, probably as a result of oxygen loss. Optical absorption was measured in the 0.35-10-μ wavelength range. After irradiation there were no substantial changes in optical absorption in the short-wave portion of the spectrum (up to 1.5 μ); in the long-wave portion a transparency increase of up to 15% was observed. Although few definite conclusions concerning the mechanism of changes in electrical conductivity resulting from irradiation were reached, it is believed that increased electrical conductivity after irradiation is due partly to the structural defects caused by irradiation and partly to the ionization processes in the specimen which result from its radioactivity. (OTS)

10634 EFFECTS OF γ RADIATION ON DISPLACEMENT IN Ni–Zn FERRITES. E. I. Tinkler, V. A. Gol'din, and V. B. Osipov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1411-13(Nov. 1961). (In Russian)

Effects of γ radiation on displacement in nickel–zinc specimens at −200 to 0°C were investigated. A 45,000 g-equiv Co^{60} source giving a dosage of 510-r/sec, was used. The specimen penetrability and characteristic displacement are plotted as functions of temperature and rate of the process. The effects of irradiation are most pronounced at −196 and −125°C. (R.V.J.)

10635 DESIGN OF IRRADIATION EXPERIMENTS. J. R. Atkinson (United Kingdom Atomic Energy Authority, Dounreay, Caithness, Scotland) and S. Rigg. J. Brit. Nuclear Energy Soc., 1: 69-85(Jan. 1962).

The effect of in-pile irradiation on fissile and non-fissile materials is discussed briefly, distinction being drawn between the effects of neutrons, β particles, and γ rays. The design of experimental equipment needed to investigate these effects is also discussed. Methods for determining the fluxes and heat generation in test rigs are given. Five experiments are described in some detail. The description of the carbon dioxide semi-static experiment gives a method of controlling the non-fissile specimen temperature in-pile. The graphite-carbon dioxide dynamic mass transfer experiment is designed to investigate the transfer mechanism in graphite-moderated carbon-dioxide-cooled reactors. The liquid metal mass transfer experiment poses special problems of safety. The description of the water-cooled fuel specimen experiment shows how the temperature of the specimen is maintained constant even during pile shut-down. The advanced gas-cooled reactor (AGR) fuel cluster experiment is described to show the difficulty of simulating operating reactor condition in a materials-testing reactor. (auth)

10636 ON THERMAL STRESSES IN CYLINDERS SUBJECTED TO γ-RAY HEATING. N. A. Weil (Armour Research Foundation, Chicago). J. Eng. Ind., 84: 35-41 (Feb. 1962).

Thermal stresses in cylinders, perfectly insulated on the outside and subjected to internal heat generation due to γ-ray radiation, are considered. Numerical values for the governing stress are presented up to $q = 7$ and $\eta = 100$.

The asymptotic values are indicated, which permits the treatment of any problem of practical interest. Three simplified solutions, containing only elementary functions, are evaluated. These approximations are found to be surprisingly accurate, at least one of them being of sufficient engineering accuracy over the entire range of variables. (auth)

10637 ON THE CHANGE OF SURFACE STATES OF GERMANIUM BY IRRADIATION. Kiichi Komatsubara (Central Research Lab. of Hitachi, Ltd., Tokyo). J. Phys. Soc. Japan, 17: 62-9(Jan. 1962). (In English)

The change in electronic behavior of the Ge surface caused by γ or electron irradiation was studied. This change is observed by picturing the field effect patterns of the surface recombination velocity, i.e., S ~ E patterns, on the cathode ray oscilloscope. The surface electric charge gradually increases negatively as irradiation progresses. After the irradiation, a complex structure appears in S ~ E curves. It is assumed by analyzing these curves that either a new surface level appears, or level density increases as a result of the irradiation. (auth)

10638 FAST NEUTRON BOMBARDMENT OF VOLTAGE-VARIABLE CAPACITORS. J. K. D. Verma (Saha Inst. of Nuclear Physics, Calcutta). J. Phys. Soc. Japan, 17: 242(Jan. 1962). (In English)

Junction capacitance behavior before and after irradiation is discussed for reverse bias values of up to 20 v. Silicon "varicaps" used for p-n junctions were bombarded using 14-Mev neutrons. Capacitance decreased at up to 2 to 4 v and increased thereafter. (L.N.N.)

10639 THERMOLUMINESCENCE OF GAMMA-IRRADIATED KCl. Kazuyuki Akasaka, Noriaki Itoh, and Tokuo Suita (Osaka Univ.). J. Phys. Soc. Japan, 17: 243-4 (Jan. 1962). (In English)

Investigations of thermoluminescence in each color-center formation stage and of the correlation between the thermoluminescence and thermal bleaching of color centers were made. Harshaw KCl was gamma irradiated in a Co^{60} cave at room temperature. As the irradiation came into the second stage, the luminescence due to the first stage F center gradually diminished, and that of the second stage F center became dominant. At above 2×10^7 r, where the relative amount of the first stage F center was below 10%, the lower temperature peak shifted considerably to higher temperatures as the dosage increased. The plastic deformation prior to irradiation caused remarkable changes in glow curves. (L.N.N.)

10640 IRRADIATION EFFECTS IN STRAIN-AGED PRESSURE VESSEL STEEL. M. Grounes and H. P. Myers (Aktiebolaget Atomenergi, Tystberga, Sweden). Nature, 193: 468-70(Feb. 3, 1962).

Results of Charpy V-impact tests, sub-size impact tests, and tensile tests show that both neutron irradiation and aging cause deterioration in the properties of mild steels by increasing the brittle-ductile transition temperature. Both these effects are additive. The steel tested was a modified version of the Swedish standard steel SIS 142103, being an aluminum-killed carbon manganese steel. (N.W.R.)

10641 MEASUREMENTS OF ELECTROMOTIVE FORCES INDUCED IN DIELECTRICS IRRADIATED BY X-RAYS. F. I. Kolomoytsev, A. Ya. Yakunin, and O. N. Sviridenko. Nauch. Zapiski, Dneporopetrovskii Gosudarst. Univ., 72: 3-6(1957).

The emf ε induced in polyethylene insulation by x irradiation was measured. The temperature course of emf was established within the range of temperatures from −30 to +70°C; it obeys the law: $\epsilon = A \exp(u/kT)$, where u = 0.5 ev and $A = 1.7 \times 10^{-7}$ v is a constant. At a temperature of −30°C the ε-value attains ~10^3v. The temperature dependence of polyethylene electric conductivity was measured for an external voltage of the same or opposite sign to that of induced ε, as well as the temperature dependence of dark electrical conductivity. It follows from the slope of the curves that the activation energy of dark carriers is higher than that of the induced ones. All the curves blend with the rising temperature, which indicates the lowering of the excitation effect at high temperatures. (OTS)

10642 RADIATION AND MONOMERS IMPROVE PROPERTIES OF WOOD. Nucleonics, 20: No. 3, 94(Mar. 1962).

When a monomer is forced into wood and polymerized with radiation, properties such as dimensional stability, water absorption, strength, and hardness generally improve with increasing polymer content. The effects of three monomers (vinyl acetate, methylmethacrylate, and styrene) at cobalt-60 gamma dose rates to 2.6×10^5 r/hr and doses to 10^7 roentgens on sugar maple sapwood are given. (N.W.R.)

10643 PRODUCTION OF V_3 CENTERS IN KCl BY X RAYS. R. W. Christy and D. H. Phelps (Dartmouth Coll., Hanover, N. H.). Phys. Rev. 124: 1053-60(Nov. 15, 1961).

The growth of the V_3 band was studied in x-ray-irradiated KCl at room temperature by measuring the optical absorption as a function of x-ray dose. In the region in which the F band grows linearly with time (after the initial "fast coloration"), the V_3 band height increases approximately as the square root of the time. The V_3 band growth rate varies with x-ray intensity and depth in the crystal in the same way as that of the F band, however. Although the F band can be optically bleached without affecting the V_3 band, if the F band is optically bleached during the x-ray irradiation, the V_3 band likewise fails to grow. These facts are likely to be consistent with a model of the V_3 center in which a Cl_3^- molecular ion is located at a cation vacancy. The center could be formed by the x-ray production of an anion vacancy-interstitial pair and the diffusion of a cation vacancy to the interstitial. (auth)

10644 ENERGY-DEPENDENT BEHAVIOR OF INTRINSIC CLOSE-PAIR DEFECTS WITHIN COPPER. Robert L. Chaplin and Paul E. Shearin (Univ. of North Carolina, Chapel Hill). Phys. Rev. 124: 1061(Nov. 15, 1961).

The low-temperature substages of high purity copper, which are associated with close-pair Frenkel defects, were measured following 2-Mev electron irradiations. Results are in the region of multiple defect production and show that a correlation exists between prior experimental work performed by lower energy electron and 10-Mev deuteron bombardments. It is evident that each intrinsic substage possesses a definite dependence upon irradiation energy. (auth)

10645 LOW-TEMPERATURE LENGTH CHANGE MEASUREMENTS OF ELECTRON-IRRADIATED GERMANIUM AND SILICON. Frederick L. Vook (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 125: 855-61 (Feb. 1, 1962).

Precision measurements of the change in length of high-purity germanium and silicon were made upon 2-Mev electron irradiation and annealing. Two germanium samples were irradiated at maximum temperatures of 365 and 86°K, respectively. The first sample was irradiated at 33 $\mu a/cm^2$ to an integrated flux of 5.4×10^{19} electrons/cm^2. The specific length expansion obtained was $\Delta L/L = (6 \pm 12) \times 10^{-26}$

per 2-Mev electrons/cm^2. The 86°K sample was irradiated at 10 μa/cm^2 to an integrated flux of 3.0×10^{19} electrons/cm^2. The specific length expansion was $(1.5 \pm 3.9) \times 10^{-25}$ per 2-Mev electrons/cm^2. Using the Seitz-Koehler simple theory of displacement (E_d = 30 ev) and assuming no annealing at the low temperature, a concentration of displaced pairs equal to 1.6×10^{-3} is calculated with a corresponding fractional atomic volume change per interstitial-vacancy of $(f_i + f_v)_{Ge} = 0.008 \pm 0.021$. The silicon sample was initially irradiated at ~50°K to an integrated flux of 8.3×10^{18} electrons/cm^2 and further irradiated at ~115°K to a total integrated flux of 7.9×10^{19} electrons/cm^2 and then annealed to room temperature. The specific length change for both bombardments was $\Delta L/L = (4 \pm 19) \times 10^{-26}$ per 2-Mev electrons/cm^2. The theory (E_d = 28 ev) predicts a concentration of displaced pairs of 4×10^{-3} with a corresponding volume change per interstitial-vacancy of $(f_i + f_v)_{Si} = 0.002 \pm 0.011$. These values are much smaller than would be expected from previous results for deuteron and neutron irradiations of germanium. Calculations of defect cluster size distributions for electron, deuteron, and neutron irradiations of germanium are given and combined with the experimental results to indicate that the volume change per defect is nonlinear and increases as the cluster size increases. The samples were not observed to expand within the presumed error. All measurements did, however, yield a small positive value. The values for Ge and Si are very small compared with the large expansions recently observed for electron-irradiated InSb and GaAs. (auth)

10646 THE INCREASE OF THE X-RAY DECOLORATION OF KCl CRYSTALS BY PRELIMINARY IRRADIATION WITH IONIZING BEAMS. K. Thommen (Universität, Bonn). Z. Naturforsch., 16a: 992-1001(Oct. 1961). (In German)

KCl crystals decolored by ionizing beams could be further bleached by tempering at 200°C; however, the crystals show an increased decoloration by x rays. The production of F, M, and V centers by x radiation after preliminary irradiation with deuterons and x rays and finally thermal bleaching was investigated. The results indicate that at least a part of the vacancies produced in the preliminary irradiation collect during tempering into clusters, which in turn are annealed out at about 300°C with an activation energy of 1.97 ± 0.15 ev. (tr-auth)

10647 DETERMINATION OF THE ANION VACANCY CONCENTRATIONS IN NaCl CRYSTALS AFTER X RADIATION. F. Froehlich (Universität, Halle, Ger.). Z. Naturforsch., 16a: 1100-3(Oct. 1961). (In German)

The concentration of anion vacancies in NaCl crystals was determined, and the behavior of the vacancies produced by x radiation was investigated during bleaching and extended irradiation experiments. The concentration of the F centers as a function of the irradiation time is shown graphically for crystals with no preliminary irradiation, with preliminary bleaching, and with extended bleaching. The results are analyzed. (J.S.R.)

10648 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON SEMICONDUCTOR PHYSICS, PRAGUE, 1960. New York, Academic Press and Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961. 1133p. $35.00.

Two hundred and seventy papers are included; separate abstracts have been prepared for six. Two papers were previously abstracted in NSA. 188 papers are in English, 37 in Russian, 25 in German, and 20 in French. The information is devoted to the fundamental problems in the physics of semiconductors, both from the experimental and theoretical points of view. Information is given on band structure and related problems, transport phenomena, recombination, radiation damage, optical properties, optical and magneto-optical effects, photoconductivity, surface phenomena, resonance, thermal properties and thermoelectricity, ionic crystals, and semiconductor materials. (N.W.R.)

10649 IN-PILE HALL COEFFICIENT MEASUREMENTS OF GERMANIUM BOMBARDED BY FAST NEUTRONS. J. Suwalski and B. Buras (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw). p.292-6 of "Proceedings of the International Conference on Semiconductor Physics, Prague, 1960." New York, Academic Press and Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961. (In English)

The Hall coefficient and the electrical conductivity of germanium bombarded by fast neutrons from a reactor were investigated. Measurements in the neighbourhood of the intrinsic region were made. A fairly good agreement between experimental and calculated Hall curves was obtained by using a three-carrier model. The concentration ratio and the mobility of the light holes were calculated independently from measurements in different magnetic fields. (auth)

10650 EFFECTS OF FAST NEUTRONS ON THE RECOMBINATION PROCESSES OF ELECTRON-HOLE PAIRS IN GERMANIUM OF n AND p TYPE. N. Van Dong and L. Koch (Centre d'Etudes Nucléaires, Saclay, France). p.297-8 of "Proceedings of the International Conference on Semiconductor Physics, Prague, 1960." New York, Academic Press and Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961. (In French)

The n- and p-type germanium crystals were irradiated by fast neutrons in a reactor at ambient (300°K) and liquid nitrogen (77°K) temperatures. Electric conductivity and Hall coefficient measurements indicate a larger increase in defects in the n-type crystal. Carrier lifetimes were measured as functions of neutron flux and bombardment temperature. The results were analyzed by the Shockley-Read equation for determining the recombination properties produced by the radiation. In the n-type crystals, the results show that electron-hole recombination is located in the lower half of the forbidden energy band. The effective capture cross sections of electron-hole pairs are: $\sigma_n = 10^{-15}$cm^2 and $\sigma_p = 10^{-18}$cm^2. In the p-type crystals, the results obtained are in disagreement with the Shockley-Read theory. A study of electron lifetime after annealing suggests a multiple level model. The annealing shows that the recombination centers are restored more in the p-type than in the n-type. (N.W.R.)

10651 HIGH ENERGY ELECTRON IRRADIATION OF SEMICONDUCTORS. V. A. J. van Lint, E. G. Wikner, and P. H. Miller, Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.306-8 of "Proceedings of the International Conference on Semiconductor Physics, Prague, 1960." New York, Academic Press and Prague, Publishing House of the Academy of Sciences, 1961. (In English)

N-type germanium and p-type tellurium were irradiated at 80°K with 25-Mev electrons; n-type floating-zone refined silicon was irradiated at 300°K. Carrier removal rates calculated from conductivity and Hall-effect measurements were 4.0 cm^{-1} for Ge at 80°K, 0.18 cm^{-1} for Si at 300°K, and 4.4 cm^{-1} for Te at 80°K. The electron Hall mobility in Ge decreased significantly during irradiation, although the hole mobility was large when the sample became p-

type. The mobility in Te was observed up to a value characteristic of less pure specimens. (auth)

10652 INFRARED ABSORPTION IN IRRADIATED SILICON. H. Y. Fan and A. K. Ramdas (Purdue Univ., Lafayette, Ind.). p.309-12 of "Proceedings of the International Conference on Semiconductor Physics, Prague, 1960." New York, Academic Press and Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961. (In English)

Two types of absorption bands produced in silicon by neutron or electron bombardment are discussed: the 1.8 μ band and a number of bands in the 9 to 14 μ region. Most of the bands in the latter group depend on the presence of dispersed oxygen. The 1.8 μ band is produced by neutron irradiation irrespective of impurities in the sample. The center has an axis along (110) directions, probably due to vacancy or interstitial pairs. (auth)

10653 MAGNETO-RESISTANCE OF γ-IRRADIATED n-TYPE SILICON. R. R. Hasiguti, E. Matsuura, and K. Matsui (Tokyo Univ.). p.312-16 of "Proceedings of the International Conference on Semiconductor Physics, Prague, 1960." New York Academic Press and Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961. (In English)

Magneto-resistance in weak field of γ-irradiated n-type silicon was measured as a function of field strength and field angle at the temperature range of 83 to 290°K. The effective mass ratios were calculated from the angle dependence of magneto-resistance of unirradiated and irradiated specimens. (auth)

10654 THE THRESHOLD ENERGY FOR PRODUCTION OF IRRADIATION DAMAGE EFFECTS IN DIAMOND. C. D. Clark, P. J. Kemmey, and E. W. J. Mitchell (Reading Univ., Eng.). p.316-19 of "Proceedings of the International Conference on Semiconductor Physics, Prague, 1960." New York, Academic Press and Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961. (In English)

The changes in the optical and electrical properties of type II diamonds, induced by electron irradiation at energies in the range 0.3 to 2.0 Mev are described. The results are compared with theoretical calculations on the rates of production of vacant atomic sites and interstitial carbon atoms. For energies up to 1.0 Mev the rates of production of the absorption band at 2.0 ev can be reasonably fitted to a theoretical curve if the threshold displacement energy is assumed to be 80 ev. (auth)

10655 METHOD OF RESISTING RADIATION DAMAGE TO ORGANIC FLUIDS AND COMPOSITIONS THEREFOR. (to U. S. Atomic Energy Commission). British Patent 889,294. Feb. 14, 1962.

A compound of improved resistance to irradiation at high temperatures and suitable for use as a reactor coolant and moderator comprises a polynuclear aromatic compound and 3 to 8 wt % phenazine. Results of radiolytic experiments are presented for 50% biphenyl–50% m-terphenyl mixtures with and without 5% phenazine additive. (D.L.C.)

PHYSICS

General and Miscellaneous

10656 (AD-259848) AN INVESTIGATION OF MAGNETIC TRANSVERSE WAVES ON AN ELECTRON BEAM. Technical Report No. ONR-3. C. C. Johnson (Utah. Univ., Salt Lake City. Microwave Devices Lab.). May 8, 1961. Contract Nonr-1288(05). 39p.

An electron beam in the presence of an axial magnetic field supports four transverse waves: two cyclotron waves and two synchronous waves. A general coupling theory is developed from an electronic equation and a circuit equation to describe how these waves can be coupled to traveling-wave circuits. The polarization and power flow characteristics of the waves are derived and substantitated by physical arguments. This theory is applied to the bifilar helix, a circuit which can couple selectively to each of the four modes. A bifilar helix traveling-wave tube was used to investigate experimentally these four beam modes and provide a quantitative check of the coupling theory. (auth)

10657 (AD-260331) THERMOELECTRIC POWER GENERATION AND RELATED PHENOMENA. Bimonthly Report No. 10, July 7–September 7, 1960. (Battelle Memorial Inst., Columbus, Ohio). Nov. 15, 1960. 31p.

GaAs–AlAs alloy was prepared by the solute buildup technique and its thermoelectric properties determined at high temperatures. Thermal diffusivity measurements were made for InSb at 25 to 500°C and for GaAs at 25°C. Studies were made of the adiabatic and isothermal Hall coefficients of PbTe and the results analyzed. (D.L.C.)

10658 (AFCRL-253) A CESIUM VAPOR THERMIONIC CONVERTER USING A THORIUM DISPENSER CATHODE. Scientific Report No. 1. J. M. Houston (General Electric Co. Research Lab., Schenectady, N. Y.). May 1960. Contract AF19(604)-5472. 11p. (AD-260357)

A thermionic heat-to-electricity converter was tested which consisted of 13.3 cm^2 Th dispenser cathode spaced 1 mm from a Cu or fernico anode. Current-voltage characteristics and power output were taken as a function of cathode temperature and Cs pressure. At a cathode temperature of approximately 2200°K, an anode temperature of 450°K, and a Cs pressure of 2×10^{-2} mm, a d-c power output of 42 watts was delivered to a resistive load at an over-all efficiency of 7%. The effect of anode temperature on converter power output was explored by recording a series of current-voltage plots at different anode temperatures. The power output went through a maximum at an optimum anode temperature where the anode work function was minimum (optimum Cs coverage). The changes in anode work-function were also observed by measuring the thermionic emission from the anode. The effect of an applied axial magnetic field on the converter output was explored. At low Cs pressures a field of 20 gauss reduced power output to $\frac{2}{3}$ of its zero-field value. At high Cs pressures a magnetic field of 80 gauss had no measurable effect on converter output. (auth)

10659 (AFCRL-283) CESIUM ION NEUTRALIZATION OF THERMIONIC CONVERTERS. Scientific Report No. 5. J. M. Houston and M. D. Gibbons (General Electric Co. Research Lab., Schenectady, N. Y.). Mar. 1961. Contract AF19(604)-5472. 20p. (AD-260361)

Calculations are made of the range of cathode work function and temperature where ion neutralization of a Cs-filled thermionic converter can occur. A simple model for neutralization is assumed in which all ions are created at the cathode by surface ionization and no ion trapping occurs. The calculations indicate that ion neutralization of an electron emission of 1 amp/cm^2 or greater can only be achieved at cathode temperatures below 1500°C by using high Cs pressures (e.g., 10 mm Hg or more) where electron scattering by Cs atoms may be serious. Experimental data for the neutralization of a converter using a Cs-on-W cathode are presented and shown to agree reasonably well with theory. At high Cs pressures, experimental results indicate that ion generation by electron impact can also occur due to the abrupt onset of what is believed to be an anomalous low-voltage arc. (auth)

10660 (AFCRL-337) TRANSMISSION THROUGH AN IONIZED MEDIUM IN THE PRESENCE OF A STRONG MAGNETIC FIELD. Technical Report No. 74. H. Rothman and T. Morita (Stanford Research Inst., Menlo Park, Calif.). May 1961. Contract AF19(604)-3458. 20p. (AD-259157)

The effects of UHF telemetry signals propagating through ionized regions were investigated. The effects of applying strong local magnetic fields to transmission of radio waves through highly conductive plasmas close to the surface of slot antennas in ground planes are described. To obtain enhancement of transmission, a particular relationship must exist among the collision frequencies of such plasmas, the electron gyrofrequency of the magnetic fields, and the impressed angular frequencies. Data showing the amplitude levels of the orthogonal components of the radiated field in the afterglow region of a pulse RF discharge indicate that magneto-ionic enhancement is achieved. In addition to this enhancement, the magnetic field exerts a pressure on the plasma which causes it to bloom within the confines of the magnetic field lines. Consequences of this perturbation on the propagation are discussed. (auth)

10661 (AFCRL-400) INVESTIGATION OF EMISSION FROM ELECTRODE SYSTEMS IN CESIUM VAPOR. Scientific Report No. 9. M. D. Gibbons (General Electric Co. Research Lab., Schenectady, N. Y.). Mar. 1961. Contract AF 19(604)-5472. 36p. (AD-260365)

Emission measurements from various electrode systems are described, and observations on hot cathode discharges in Cs vapor are presented. Emission measurements give the boundary conditions at the electrode surfaces in thermionic converters, and possibly give an indication of the relative bond strength of Cs to the electrode surface. The importance of the interplay of electron space charge effects and surface ionization is shown. The general form of the Ta–Cs emission system was measured. Ta offers a more suitable anode material for the converter than W. The so-called second mode was shown to be a hot cathode discharge. (auth)

10662 (AFCRL-802) ANALYSIS AND REDUCTION OF DATA RECORDED UNDER PROJECT COWBOY. Final Report. Robert W. Wylie (Texas Instruments, Inc., Dallas). July 11, 1961. Contract AF19(604)-8078. 60p. Project VELA UNIFORM. (AD-261745)

The analyses conducted under Project Cowboy were performed on eight chemical detonations. The shots consisted of 200-, 500-, and 1000-pound decoupled shots in a 30-ft spherical cavity. An additional decoupled 1000-pound shot was detonated in a 12-ft spherical cavity. Tamped shots had yields of 200, 500, and two 1000 pounds. Analyses from the

data recorded indicated the following results: the predominant energy of the decoupled signals is concentrated in the first few arrivals whereas the tamped signals are characterized by many arrivals of rather constant amplitude; the 500- and 1000-pound tamped and decoupled shots revealed that the tamped shots transmitted a greater quantity of low frequency energy than the decoupled shots; the total seismic energy is partitioned differently between the various modes of propagation for tamped and decoupled shots and is a function of the size of the explosive and cavity; the effect of decoupling can be thought of as a linear filtering of the tamped signal response; and amplitude density ratios computed from spectral response characteristics indicated that the decoupling is a function of frequency, shot size, and distance from the source. Seismic attenuations are usually frequency dependent; therefore, the decoupling analysis presented is based on defining decoupling as the amplitude density ratio as a function of frequency. Depending on the time length and area of the seismogram from which the samples are selected, the ratios of the average amplitude response can describe the decoupling as determined for the first arriving refractions, body wave segment of the record, or the total seismic signal return. These ratios are only dependent upon the seismic signal and noise variations. The analysis included energy density spectra of signals and power density spectra of the noise samples for the 500- and 1000-pound decoupled and tamped events. Time samples were analyzed, e.g., 0.256-second samples of the first arrivals and 2.048-second samples of noise and signal. Surface wave energy is not included in the analysis. Seventeen shots were detonated under Project Cowboy in an effort to establish the decoupling capabilities of cavity source environments for nuclear detonations. Texas Instruments participation was to determine the characteristics, and analyze the data obtained, of decoupled shots, seismometer coupling, environment, and travel paths relative to chemical explosions in spherical cavities. The test shots were conducted in early 1960. Special research equipment built with company funds for use in seismic research was used in the analysis and reduction of data gathered. S-41 seismometers having a frequency of 4 cps were used to monitor the eight shots. (auth)

10663 (AFOSR-1842) LIFETIME OF THE EXCITED F-CENTER. Technical Note No. 9. Robert K. Swank and Frederick C. Brown (Illinois. Univ., Urbana). Nov. 1961. Contract AF49(638)-579. 17p.

Because of the strong absorption of the F-band in alkali halide crystals, it was generally assumed that the radiative lifetime of the excited state would be of the order of that for an allowed atomic transition, i.e., about 10^{-9} sec. Direct measurements of this lifetime are reported showing that it is of the order of 10^{-6} sec. In addition, it is shown how measurements of photoconductivity, luminescence, and lifetime may be used to obtain interesting information about the excited states of the F-center. (auth)

10664 (AFOSR-2040) MAGNETORESISTANCE OF THE SILVER HALIDES. Technical Note No. 10. Harry H. Tippins, Jr. (Illinois. Univ., Urbana). Dec. 1961. Contract AF49(638)-579. 55p.

The effect of a magnetic field on the conductivity of silver halides is discussed. An attempt was made to determine whether results of magnetoresistance measurements in AgBr were consistent with the assumptions of a spherical conduction band and isotropic relaxation time. A theory was developed based on this model. The results of some preliminary measurements made on AgCl are presented in addition to the data for AgBr. Results are presented in graph form. The data indicated the assumption of a spherical conduction band is valid. (M.C.G.)

10665 (AFOSR-2045) PART I. EXCITONS AND PLASMONS IN SUPERCONDUCTORS. PART II. LIFETIME EFFECTS IN CONDENSED FERMION SYSTEMS. Technical Report No. 1. Angelo Bardasis (Illinois. Univ., Urbana). Nov. 1961. Contract AF49(638)-882. 114p.

The exciton mode in the superconductor was interpreted as a bound pair of quasi-particles whose center-of-mass propagates with a certain momentum. The exciton spectrum was investigated through the generalized random-phase approximation equations of motion involving quasi-particle operators. It was found that excitons may be characterized by the approximate quantum numbers L and M describing the symmetry of the states with respect to the relative coordinate. The plasmon state corresponds to an s-state exciton whose energy is greatly increased by the long-range Coulomb interaction. To obtain solutions to the equations, matrix elements of the equations were taken between a state with one collective excitation and the ground state which was renormalized so as to include the zero-point motion of the collective modes. The results gave two sets of solutions one of which is shown to be unphysical. The generalized random-phase approximation is discussed from a diagrammatic point of view. Solutions for the collective excitations are presented. An analysis was made of the lifetimes in fermion systems. The basis for the analysis was a calculation of the fermion self-energy diagram whose imaginary part is related to the damping rate. A formalism is outlined for working with damping effects in a fermion system and the consequences of certain assumed forms for this damping are considered. It was found that the damping of excited states will tend to reduce the net attractive interaction necessitating a corresponding lowering of the critical temperature. (M.C.G.)

10666 (DC-58-4-54) WATER-AIR BOUNDARY DOSE RATE MEASUREMENTS USING A COBALT-60 SOURCE. V. J. Mitchell and R. B. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 7, 1958. Contract AT(11-1)-171. 18p.

Experiments were conducted in the Hot Cell pool during January 1958, using a Co^{60} source, investigating the effect of a water-air boundary on dose rates. The experimental results compare favorably with the Monte Carlo calculations of other workers. (auth)

10667 (DC-60-1-106) STUDY OF ABSOLUTE CALIBRATION OF GAMMA RAY SOURCES. V. J. Mitchell (General Electric Co. Aircraft Nuclear Propulsion Dept.). Jan. 7, 1960. Contract AT(11-1)-171. 17p.

The difficulties and techniques of the absolute determination of radioisotopic disintegration rates were studied in the literature. Brief discussions of all essential methods are presented, followed by detailed discussions of the coincidence and ionization chamber counting methods, with special attention to Cs^{137}, Co^{60}, and Na^{24}. (auth)

10668 (DC-60-2-215) ANALYSIS OF GAMMA RAY POINT SOURCE DATA FROM SINGLE MATERIAL MEASUREMENTS (MILESTONE II, JOB 51292, TASK 431321). V. J. Mitchell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 23, 1960. Contract AT(11-1)-171. 31p.

Data from single material (water, aluminum, iron, lead, hevimet, and uranium) measurements using cobalt and cesium sources were reduced to buildup factors for comparison with moments method calculations of dose buildup factors. Disagreement between measured and theoretical buildup was observed, but it was decided that the amount

of existing data is insufficient to justify any firm conclusions. Additional specified measurements were requested. (auth)

10669 (EFINS-61-17) QUASI-PARTICLES AND TRANSPORT PHENOMENA. Gregor Wentzel (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). Feb. 1961. Contract [AT(11-1)-104]. 16p.

It is shown that the concept of quasi-particles, as temperature-dependent entities, can be usefully applied even in non-equilibrium situations. However, in problems where the deviations from thermal equilibrium are decisive, the residual interactions between quasi-particles may no longer be irrelevant. A case in point is the thermal (and electric) conductivity of a superconductor. (auth)

10670 (JINR-P-836) PLOSKAYA ZADACHA FORMIROVANIYA MAGNITNOGO POLYA V ZAZORE SIMMETRICHNOGO MAGNITA. (Plane Problem of Magnetic Field Formation in Symmetric Magnet Gap). G. N. Vyalov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1961. 14p.

A solution is presented for the two-dimensional problem of forming the magnetic field in the gap of a symmetrical magnet made of ideal magnetic material limited by an arbitrary contour. The edge effect is considered in the case where the magnetic field is formed by the rectilinear current in the magnet gap with a rectiangular edge. (auth)

10671 (LAMS-2628) ATOMIC HYDROGEN RECOMBINATION AND CATALYSIS BY MOLECULES AND PARTICLES. Keith A. Brueckner (Los Alamos Scientific Lab., N. Mex.). Aug. 23, 1961. Contract W-7405-eng-36. 12p.

A study was made of the possibilities for increasing the rate of recombination of atomic hydrogen with catalysis, either by molecules or by solid particles. Various limiting factors were considered, such as the lifetime of the intermediate excited molecular complex in the former case and the temperature of the solid particles as governed by radiation and conduction in the latter case. (auth)

10672 (MRL-110) HYPERFINE FIELDS IN MAGNETIC MATERIALS: SURVEY. A. J. Freeman (Watertown Arsenal. Materials Research Lab., Mass.), and R. E. Watson (Avco Mfg. Corp. Research and Advanced Development Div., Wilmington, Mass.). Dec. 1961. 17p.

Presented at 2nd International Conference on the Mössbauer Effect, Saclay, France, Sept. 13-15, 1961.

The origin of hyperfine fields in magnetic materials is discussed with emphasis on developments which have occurred since the First Conference on the Mössbauer Effect (June 1960). (auth)

10673 (NAA-SR-6550) TEMPERATURE DISTRIBUTION IN A HOLLOW CYLINDRICAL CUP WITH A STEM. Guy W. Lehman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 15, 1962. Contract AT(11-1)-Gen-8. 20p.

An approximate analytical approach for determining the temperature distribution in a hollow cylindrical cup of radius C having a base thickness H with a stem of radius A and length L is given. The outer radial surface of the cup is held at a temperature T_0 and the temperature at the bottom of the stem is T_s. All other surfaces are adiabatic. This geometrical arrangement is used to observe marker motion under the influence of a large thermal gradient in a thermal diffusion experiment. In this setup, only the sink temperature, T_s, and the temperature at the bottom of the cup, T_m, can be measured. Equations are presented which enable a calculation to be made of the temperature and its gradient along the axis of this arrangement with relative ease for the physically important case $A/C < 1/4$. In the region along the axis above the cup-stem interface, the temperature at any point is given in terms of T_m, T_s, and functions which depend only upon the ratio A/H. A table of these functions is presented for the cases $\pi A/H = 0.4$, 0.8, and 1.2. (auth)

10674 (NAVWEPS-7205) INFRARED ATOMIC SPECTRA. Reprinted from: Quarterly Report Foundational Research Projects, July–September 1961. C. J. Humphreys, E. Paul, Jr., and K. B. Adams (Naval Ordnance Lab., Corona, Calif.). 30p.

Work on the infrared spectra of the noble atmospheric gases is described. Newly observed features that involved an extension into a portion of the infrared region previously unexplored for these spectra, as well as a new set of interferometric measurements on the first spectrum of natural krypton, are presented. Results extending the descriptions of the noble gas spectra are presented in the form of diagrams and tables. (M.C.G.)

10675 (R61SD100) THE COMBINED EFFECT OF TENSOR CONDUCTIVITY AND VISCOSITY ON AN MHD GENERATOR WITH SEGMENTED ELECTRODES. A. Sherman and G. W. Sutton (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). June 1961. Contract AF49(638)-914. 26p. (AFOSR-687; AD-260366).

An investigation of the combined influence of tensor conductivity, fluid viscosity, and segmented electrodes was carried out for an MHD generator. A solution for the flow field and induced magnetic field was obtained in closed form by assuming an incompressible, constant properties fluid, and two-dimensional flow. Calculations are presented which show the influence of $\omega_e\tau$ (product of electron cyclotron frequency and electron mean free time), H_α (Hartmann number), and k (generator loading parameter) on the flow. In particular, the efficiency is increased by increasing $\omega_e\tau$. This unexpected result can be shown to be due to velocity profile distortions caused by increasing $\omega_e\tau$. (auth)

10676 (SC-4669(RR)) "INVARIANT IMBEDDING" AND WAVE PROPAGATION IN INHOMOGENEOUS MEDIA. Crawford J. MacCallum (Sandia Corp., Albuquerque, N. Mex.). Nov. 1961. Contract [AT(29-1)-789]. 158p.

The study of wave propagation in one dimensional inhomogeneous media is undertaken using the mathematical approach recently developed under the name "invariant imbedding." The specific problem posed is to find the transmission and reflection amplitudes for waves incident on an inhomogeneous "transition region" separating two homogeneous media. By "imbedding" the actual problem into a continuum of problems generated by a real parameter, first-order nonlinear differential equations for the amplitudes are constructed; these contain an arbitrary function to be chosen appropriate to the physical situation. Integral equations are constructed which yield very powerful approximations; in particular, improvements over the Born and WKB approximations are discussed. The Bremmer-Glauber series is rederived. Applications discussed include reflection of microwaves from a plasma boundary, reflection of elastic or electromagnetic waves obliquely incident on a stratified medium, determination of phase shifts in a partial wave analysis of spherical scattering, and determination of quantum mechanical energy levels in one dimension. (auth)

10677 (TID-14984) ALPHA QUARTZ PIEZOELECTRIC CONSTANT FOR HIGH TRANSIENT STRESS. R. A. Graham (Sandia Corp., Albuquerque, N. Mex.). Jan. 12, 1962. Contract [AT(29-1)-789]. 16p.

For presentation at Austin American Physical Society Meeting, February 23-24, 1962.

The one-dimensional strain piezoelectric constant for X-cut synthetic quartz was determined for impact stress from 4 to 40 kbar. Flat cylinders of quartz were impacted upon each other with precise alignment control. The impact stress was computed from the measured impact velocity and the piezoelectric charge was obtained from short-circuited current measurements. The specimens were a "guard-ring" type geometry to insure one-dimensional strain and electric field. Below 8 kbar the piezoelectric ratio of electric charge to stress was 2.04×10^{-8} coul/cm^{2}kbar which agreed with low signal constants within the experimental error of 3%. For +X oriented crystals between 10 and 21 kbar the ratio was 2.16. At 21 kbar the ratio of the change in electric charge for a change in stress increased to 3.3×10^{-8} coul/cm^{2}kbar and did not change to at least 40 kbar. A definite dielectric anomaly existed above 10 kbar for –X oriented crystals. (auth)

10678 (UCRL-5926) THE STATE OF MATTER AT HIGH PRESSURES. A Bibliography, [from] 1950–October 1959. Zanier D. Lane (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 1, 1960. Contract [W-7405-Eng-48]. 18p.

A selected bibliography of books, journal articles, and unclassified reports published on the state of matter at high pressures from 1950 to October 1959 is presented. The 191 references are grouped under the following headings: instrumentation, spectra, electrical and magnetic properties, chemistry, equation of state, planets, earth, theory, and other properties. (M.C.G.)

10679 (UCRL-6626) ADSORPTION OF HYDROGEN ON SOLIDIFIED-GAS FILMS. Angus L. Hunt, Clyde E. Taylor, and John E. Omohundro (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 4, 1961. Contract W-7405-Eng-48. 24p.

It was found that hydrogen is rapidly adsorbed at 11°K on solidified-gas films of A, N_2, O_2, H_2O, N_2O, and CO_2. From hydrogen pumping speed measurements in the 10^{-9} mm Hg pressure range on solidified-gas substrates of geometrical area 3×10^3 to 5×10^3 cm^2, it was estimated that the initial sticking probabilities for room-temperature hydrogen are between 0.1 and 1.0 for coverages to about one monolayer, depending on the composition of the solidified-gas substrate. Most of the adsorbed hydrogen is desorbed between the hydrogen triple-point temperature and the normal boiling temperature. The adsorption energies were estimated to be several hundred calories per mole if calculated from an assumed monolayer surface density of 10^{15} molecules per cm^2 in a simple mobile monolayer adsorption theory. It was also found that helium is not adsorbed in comparable quantities on the solidified-gas substrate at 11°K. The results indicated that adsorption cryopumping of hydrogen in practical quantities is feasible. (auth)

10680 (AEC-tr-5010) A DIAGRAM FOR THE TEMPERATURE DEPENDENCE OF THE FREE ENERGY OF CARBIDES. Pavel Grobner. Translated from Hutnicke listy, 9: 272-4(1954). 7p.

A diagram, showing the relationship of the free energy and temperature, was constructed for various carbides. The diagram permits the evaluation of the thermodynamic stability of carbides at various temperatures. (auth)

10681 (FTD-TT-61-350) IONIZATION LOSSES AND THE CAPTURE OF SLOW, HEAVY, NEGATIVE PARTICLES. I. I. Gol'dman. Translated from Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 14, No. 1, 79-86(1961). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 28501.

10682 (FTD-TT-61-400) A PLASMA SOURCE FOR A HIGH VACUUM. B. P. Kononov and K. A. Sarksyan. Translated from Zhur. Tekh. Fiz., 31: 1294-7(Nov. 1961). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 5826.

10683 INVESTIGATION OF X-RAY ACTIVATED QUARTZ LUMINESCENCE. Richard-Thomas Bayley and Luise Holzapfel (Max-Planck-Institut für Silikatforschung, Berlin-Dahlem). Acta Phys. Austriaca, 14: 396-404(1961). (In German)

The luminescence intensity induced by x radiation in quartz dust is dependent on the previous treatment of the quartz. Singly activated quartz maintains its activity after x irradiation for a long time. The luminescence intensity maximum is affected by the length of the irradiation. The luminescence emitted by x-irradiated quartz dust consists almost exclusively of short-wave blue and UV light below 400 mμ. Comparisons of silicose-activated dust samples gave, with the exception of tridymite samples, a fixed relationship with the luminescence radiation. (tr-auth)

10684 THE DIRAC EQUATION IN GENERAL RELATIVITY IN THE VIERBEIN FORMALISM. Józef Namysłowski (Jagellonian Univ., Krakow). Acta Phys. Polon., 20: 927-36(1961). (In English)

The explicit form of the Dirac equation in general relativity is given using the Vierbein formalism. Formulas derived for the Vierbein fields allow the spinor field to be derived if the metric tensor is given. Conditions similar to the Hilbert conditions follow directly. (auth)

10685 RELATIVISTIC Z-DEPENDENT THEORY OF MANY-ELECTRON ATOMS. David Layzer (Harvard Coll. Observatory, Cambridge, Mass.) and John Bahcall. Ann. Phys. (N. Y.), 17: 177-204(Feb. 1962).

A relativistic generalization of the nonrelativistic Z-dependent theory of many-electron atoms is described. A unified description of relativistic and nonrelativistic effects in the structure and spectra of many-electron atoms is given that is valid over the entire range of the coupling parameter $\chi \equiv \alpha^2 Z^3$ and allows fully for all electronic contributions to the energy (expressed in units of mc^2) of order ϵ^k and $\epsilon^k Z^{-1}$, $k \geq 1$, $\epsilon \equiv (\alpha Z)^2$. The grouping of states into complexes, characterized by a definite set of principal quantum numbers and a definite parity, plays a central role. Relativistic and nonrelativistic contributions to the energy that involve interaction elements connecting different complexes are of order Z^{-2} as compared, respectively, with the leading relativistic and nonrelativistic contributions to the energy. However, all interactions connecting states of the same complex contribute quantities of order ϵ^k or $\epsilon^k Z^{-1}$, $k \geq 1$, to the energy. Three expansion parameters— Z^{-1}, ϵ, and χ— figure in the relativistic theory. In the nonrelativistic approximation, ϵ and χ vanish, and the energy can be expanded in powers of Z^{-1}. In general, the energy can be expressed as a double power series in Z^{-1} and ϵ whose coefficients normally depend upon χ; for $\chi \ll 1$, they can be expanded in powers of χ, for $\chi \gg 1$ in powers of χ^{-1}. A formula valid over the entire range of Z is derived. It differs from Breit's formula for $\epsilon \ll 1$ by quantities that are smaller than the Lamb shift. Relativistic level shift is evaluated for states belonging to the configurations $1s^2$, $1s2s$, $1s3s$, $1s^22s$, and $1s^23s$. Agreement between theory and experiment is obtained. (auth)

10686 IONIZATION NONEQUILIBRIUM IN EXPANDING FLOWS. Alan Q. Eschenroeder (Cornell Aeronautical Lab., Inc., Buffalo). ARS (Am. Rocket Soc.) J., 32: 196-203(Feb. 1962).

Approximate methods are developed for solving the electron-ion kinetic equations in expanding quasi one-dimensional airflows. Results are obtained for inviscid nozzle flows at conditions appropriate to shock tunnel testing and are compared with exact numerical solutions. Effects on r-f transmission and d-c conductivity are examined. Since two-body deionization never fully freezes in the flows considered, the assumption of sudden freezing gives an upper bound on the residual ionization at large area ratios. The use of an asymptotic form of solution with the freezing criterion provides an improved estimate for such cases. Ionization nonequilibrium is also considered for the plasma sheath associated with blunt hypersonic bodies flying at high altitudes. The influence of atomic ions is examined for typical re-entry conditions. (auth)

10687 THE DENSITY OF SINGLE GRAINS ALONG THE TRACK IN NUCLEAR EMULSIONS. Giuseppe Lovera (Istituto di Fisica Sperimentale del Politecnico, Turin). Atti seminar. mat. e fis. univ. Modena, 10: 31-5(1960-61). (In Italian)

A formula is deduced that relates the observed density of single grains on a track of an ionizing particle in a nuclear emulsion to the probability of development, following the constant spacing model. The formula takes into account the partial overlapping of adjacent developed grains, and agrees satisfactorily with some known experimental data concerning the Ilford G5 emulsions. (auth)

10688 A THERMIONIC GENERATOR. D. Gabor (Imperial Coll. of Science and Tech., London). Brit. Power Eng., 2: No. 6, 36-40(May 1961).

Advances in the development of the thermionic generator show that a cost figure of 0.05 to 0.1 w/amp may be achieved when argon or argon–mercury vapor is ionized by contact with a hot electrode which can be either the emitter itself or a third hot electrode. The principles, theory, electrical characteristics, optimum size, design, efficiency, and future development required are briefly discussed and described. (N.W.R.)

10689 APPLICATION OF THE "FLOATING-WIRE" TECHNIQUE TO THE STUDY OF A MAGNETIC DEFLECTOR. P. van Leuven (Centre d'Etudes Nucléaires, Mol, Belg.). Bull. classe sci., Acad. roy. Belg. (5), 47: 259-71 (1961). (In French)

The floating-wire method is used to study the proton optics of a deflecting magnet with circular pole shoes and nonuniform field. The conditions under which the system acts as a prism are determined. The question of wire stability is emphasized. It is found that, for the special experimental conditions, there exist three equilibrium configurations of equal wire current connecting two given points. Two of them are stable while the other is metastable. (auth)

10690 TEMPERATURE OF A SHIELDED SURFACE. Paul Stephas (General Electric Co., Pleasanton, Calif.). Can. J. Phys., 40: 151-62(Feb. 1962).

Expressions were derived for correcting the brightness temperature of a body surrounded by radiation shields. Calculations were made for plane parallel, coaxial cylindrical, and concentric spherical surfaces. Diffusely and specularly reflecting surfaces were considered. The error involved in ignoring this correction for tantalum or tungsten may be several hundred degrees, according to the geometry, at 3000°K. (auth)

10691 THE EFFECTIVE RANGE OF HIGH ENERGY ELECTRONS THROUGH ALUMINUM AS MEASURED BY CURRENT DETECTION. Yu-Hau Li (National Tsing-Hua Univ., Taipei, [China]). Ho Tsu K'o Hsueh, 3: No. 2, 51-6 (1961). (In Chinese)

Monochromatic electrons produced by a Van de Graaff accelerator are aimed at an aluminum target of known thickness. Secondary electrons and gammas are caught by appropriately placed Faraday cages to prevent disturbing effects. The effective ranges are determined by measuring the penetration current with a microammeter. The same technique as that of J. S. Marshall and A. G. Ward (Can. J. Research, A15: 39(1937)) is used in treating the data. The empirical equation $R = 0.533E - 0.124$ is obtained. Another empirical equation is obtained by plotting the energy of the electrons in Mev against the penetration in microamperes. The equation is $R = 0.60 - 0.15$; $1.0 < E < 3.0$ Mev. The energy of the betas from RaD + RaE is determined by this method with aluminum foils of known thickness; the experimental value is 1.18 Mev as compared with the accepted value of 1.15 Mev. (TTT)

10692 THE ULTRAVACUUM AND THE PHYSICS OF THIN FOILS. Antoine Colombani (Université, Caen, France). Inds. atomiques, 5: No. 9-10, 69-75(1961). (In French)

The first experimental works (1860) on foils were made well before the perfecting of preparation methods. In the present article two preparation methods are described, cathodic projection and thermal evaporation. Emphasis is placed on the latter method. (J.S.R.)

10693 THE ULTRA VACUUM. E. A. Trendelenburg. Inds. atomiques, 5: No. 9-10, 76-84(1961). (In French)

After a brief introduction, the bases of the physics of ultravacua and their application are described. The measurement methods and the production of ultravacuum are given, with emphasis on the principal production methods. In conclusion, the engineering problems of ultravacuum are briefly described. (tr-auth)

10694 NICKEL-ACTIVATED CALCIUM AND STRONTIUM SULFIDE PHOSPHORS. M. Avinor, A. Carmi, and Z. Weinberger (Ministry of Defense, Israel). J. Chem. Phys., 35: 1978-80(Dec. 1961).

Calcium sulfide activated by nickel and copper or nickel and silver gives an emission band at 680 and 625 mμ, respectively. In strontium sulfide the emission bands appear at 775 and 710 mμ, respectively. The presence of both activators is necessary for the production of these emissions. (auth)

10695 SCINTILLATION PROPERTIES OF 9-VINYLANTHRACENE. Adam Heller (Israel Atomic Energy Commission Labs., Rehovoth) and Dov Katz. J. Chem. Phys., 35: 1987-9(Dec. 1961).

9-Vinylanthracene, for which good scintillation properties were predicted, was found to be a high-grade primary and secondary scintillator, capable of replacing the widely used 1,4-bis-(2-(5-phenyl)-oxazolyl)-benzene (POPOP). (auth)

10696 ANALYSIS OF THE ABSORPTION SPECTRUM OF $YbCl_3 \cdot 6H_2O$. J. C. Eisenstein (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 35: 2097-2100(Dec. 1961).

The measurements of Dieke and Crosswhite on the absorption spectrum of $YbCl_3 \cdot 6H_2O$ are discussed. Their interpretation of the spectrum is extended by the identification of two of the weaker lines. The entire spectrum is considered on the basis of crystal-field theory, and the possibility of determining the parameters of the crystal-field potential is assessed. It is suggested that this compound may be ferroelectric (or anti-ferroelectric). The spin-orbit coupling constant is determined to be -2924 cm^{-1}. (auth)

10697 AN ANALYSIS OF THE INFRARED ABSORPTION SPECTRUM OF $Am^{+3}(5f^6)$ IN $LaCl_3$. John B. Gruber (Univ. of California, Berkeley). J. Chem. Phys., 35: 2186-92(Dec. 1961). (UCRL-9584)

The polarized infrared absorption spectrum of single crystals of $Am^{+3}(5f^6)$ in $LaCl_3$ was studied from 0.79 to 16.0 μ. In almost every instance the spectrum is sharp and completely polarized, and appears in definite groupings. Transitions from the ground level, $^7F_0$, to excited levels of the ground term, $^7F_1$, $^7F_2$, $^7F_3$, $^7F_4$, $^7F_5$, and $^7F_6$ were observed. For the particular point symmetry C_{3h} that is consistent with experiment, magnetic-dipole transitions are observed from the $^7F_0$ level to the $^7F_1$ level, and forced electric-dipole transitions are observed to levels J = 2, 3, 4, 5, and 6. A theoretical analysis is presented for the crystal-field split ^7F_J levels. Using four parameters– $A_2^0(r^2) = 206$ cm^{-1}, $A_4^0(r^4) = -94.1$ cm^{-1}, $A_6^0(r^6) = -93.8$ cm^{-1}, and $A_6^6(r^6) = 1100$ cm^{-1}–excellent agreement is obtained between theory and experiment. (auth)

10698 MAGNETIC INTERACTIONS IN LITHIUM HYDRIDE. M. Karplus and H. J. Kolker (Columbia Univ., New York). J. Chem. Phys., 35: 2235-6(Dec. 1961).

Variation-perturbation calculations of the magnetic susceptibility (χ) and nuclear shielding (σ_N) in LiH are reported. The simplicity of the formulation and the accuracy of the results give an indication of the feasibility of magnetic studies with approximate ground-state wave functions for many-electron systems. (P.C.H.)

10699 PATTERN INVERSION FOR COHERENT INELASTIC ELECTRON SCATTERING BY Br_2. D. A. Swick and J. Karle (U. S. Naval Research Lab., Washington, D. C.). J. Chem. Phys., 35: 2257-8(Dec. 1961).

Experimental investigations were made of both elastic and inelastic scattering of 20-kev electrons by bromine. The predicted inversion effect was observed. It is pointed out that it is experimentally possible to observe the phenomenon of pattern inversion. (P.C.H.)

10700 TIME LAG IN TRANSPORT THEORY. H. L. Frisch (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 36: 510-16(Jan. 15, 1962).

The time lag in the attainment of a stationary state or flow is defined for a class of linear and nonlinear transport equations. It is shown that the explicit calculation of the time lag can be reduced, for these equations, to the determination of the Green's function of a simpler, linear, time-independent boundary-value problem. For a linear transport equation knowledge of this Green's function enables the recursive calculation of certain time moments which afford an approximate representation of the solution. The possibility of an asymptotic exponential approach to the steady-state solution of these linear transport equations is directly related to the convergence of the sequence of these time moments. An explicit example of a nonlinear diffusion in a finite system is used to illustrate the general theory. Certain properties of the time lag for the flux of this nonlinear diffusion problem are derived in the Appendix. (auth)

10701 COLLISIONLESS EXPANSION OF GASES INTO VACUUM. Roddam Narasimha (California Inst. of Tech., Pasadena). J. Fluid Mech., 12: 294-308(Feb. 1962).

The free-molecule limit of several free-flow problems is studied on the basis of the collisionless Boltzmann equation. It is shown that the density in the free expansion of a gas cloud obeys, under certain conditions, a diffusion equation with a coefficient directly proportional to the time, and the resulting flow field is described in terms of a thick diffusion front travelling asymptotically at a definite velocity and growing linearly with time. It is also shown that in any free-molecule free expansion the stresses and heat flux can be expressed in terms of viscosity and conductivity coefficients, which however increase linearly with time but are such that the Stokesian relation is always valid and the Prandtl number has the value $\frac{8}{9}$. The flow field due to sources and jets is also discussed, and it is found that the jet has a width inversely proportional to the Mach number if the Mach number is sufficiently high. Finally, a procedure is indicated for taking approximate account of collisions among the molecules. (auth)

10702 EXPERIMENTAL EVIDENCE FOR THE PRESENCE OF HELIUM IONS BASED ON EXPLORER VIII SATELLITE DATA. R. E. Bourdeau, E. C. Whipple, Jr., J. L. Donley, and S. J. Bauer (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Research, 67: 467-75(Feb. 1962).

Values of positive-ion concentration ($N_+ = 1.3 \pm 0.1 \times 10^4$ ions/cm^3), electron temperature ($T_e = 1750 \pm 200$°K), and the ratio of atomic helium to oxygen ions ($He^+/O^+ = 1.3 \pm 0.3$), measured by three separate experiments at an altitude of 1630 km on the Explorer VIII satellite, are presented. These together with ionosonde data are consistent with a model of an isothermal upper ionosphere in diffusive equilibrium. The model infers that hydrogen ions are less important than either helium or oxygen ions at altitudes below 1600 km. The measured ratio of helium to oxygen ions is consistent with that postulated by Nicolet. (auth)

10703 THE SHAPE OF THE GEOMAGNETIC FIELD BOUNDARY UNDER UNIFORM EXTERNAL PRESSURE. Ralph J. Slutz (National Bureau of Standards, Boulder, Colo.). J. Geophys. Research, 67: 505-13(Feb. 1962).

A solution is given for the shape of the cavity separating the earth's magnetic field from the interplanetary plasma, for a model that assumes the plasma pressure to be constant over the surface of the cavity (thus giving axial symmetry). It is seen that in the equatorial plane the cavity distance from the earth's center is 37% greater than it would be if the external gas pressure were balanced by the magnetic pressure of the undisturbed dipole field of the earth. Also, along the polar axes there are cusps extending inward which reduce the cavity size along these axes to $\frac{2}{3}$ of the size in the equatorial plane. Applying these results as an approximation in the earth-sun direction for the non-axially symmetric case of solar wind gives an estimate of about 9 earth radii for the distance of the boundary from the earth's center in the direction of the sun. (auth)

10704 STABILITY OF A SIMPLIFIED GEOCYCLOTRON MODEL. John S. Lew (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). J. Geophys. Research, 67: 515-24(Feb. 1962).

Calculations are given which treat the stability of the geocyclotron, a device to accelerate electrons in the ionosphere. On the assumption of slow energy absorption (a logarithmic rate of increase much less than the bounce frequency) the change in bounce amplitude and a small drift in altitude are estimated. Equations of motion are obtained for a model geocyclotron: a relativistic charged particle in a uniform magnetic field and a rotating electric field. For a constant rotation frequency, the exact phase stability conditions are derived, and restated; for a slowly changing frequency, a quasistatic treatment is sketched. (auth)

10705 AURORAL-ZONE GEOMAGNETIC MICROPULSATIONS WITH PERIODS OF 5 TO 30 SECONDS. Wallace Campbell and Sadami Matsushita (National Bureau

of Standards, Boulder, Colo.). J. Geophys. Research, 67: 555-73(Feb. 1962).

Observations of geomagnetic micropulsations with periods of 5 to 30 sec were carried out for a year at College, Alaska. The average activity of micropulsations in the auroral zone was 4.5 times that in the middle latitudes. The average amplitude of the activity in Alaska maximized at about 0.65 γ near 0600 LMT; the minimum of 0.24 γ occurred at about 1900 LMT. There was a general association of micropulsations with the magnetic index K. Empirical relationships of magnetic pulsations with auroral coruscations of 3914 A emission, auroral ionospheric absorption, and electron bremsstrahlung were mentioned. Micropulsation storms are associated with negative bay disturbances and are related to auroral-zone electron bremsstrahlung increases as well as ionospheric absorption phenomena. The average field pulsation amplitudes maximize at the outset of such disturbances at the first indication of a rapid increase in the ionospheric current. The gross current systems measured as negative bays in H reach a maximum value more slowly than the pulsations. The electron bremsstrahlung and ionospheric density enhancements gradually maximize later in the storm development when the position of the gross current system has extended close to the observing station. All evidence seems to indicate that the micropulsation storms result from an ionospheric current system set up at times of primary electron bombardment. (auth)

10706 A CONTRIBUTION TO THE MORPHOLOGY OF X-RAY BURSTS IN THE AURORAL ZONE. G. Pfotzer (Max-Planck-Institut für Aeronomie, Lindau a. Harz, Ger.), A. Ehmert, H. Erbe, E. Keppler, B. Hultqvist, and J. Ortner. J. Geophys. Research, 67: 575-85(Feb. 1962).

Between September 16 and October 5, 1960, eight balloon flights employing thin-walled Geiger counters in conjunction with ionization chambers were carried out in the auroral zone at Kiruna, Sweden. X-ray bursts were recorded on September 27, October 1, and October 2, and were observed to be closely correlated with cosmic noise absorption (CNA). The onsets of the bursts showed close correspondence with magnetic disturbances, but in the subsequent phases only tenuous correlations were observed. The events of October 1 and 2 were probably caused by the same extraterrestrial source—possibly a beam of ionized solar gas persisting throughout two rotations of the sun. The sequential relationship of pronounced magnetic disturbances and CNA periods of several hours' duration on September 17, October 1, and October 2 is tentatively interpreted as causal. (auth)

10707 THE HEIGHTS OF IONOSPHERIC IRREGULARITIES IN THE AURORAL ZONE. Roy P. Basler and Ronald N. DeWitt (Univ. of Alaska, College). J. Geophys. Research, 67: 587-93(Feb. 1962).

Recordings of the 20 Mc/s signal strength of the satellite $1958\delta_2$ were made. A spaced-receiver technique for measuring the heights of the irregularities responsible for the violent scintillations observed in these signals gives evidence that their altitudes ranged as high as 1000 km. A method for determining the height distribution of these irregularities, based on the amount of scintillation recorded when the satellite was at different altitudes, shows that they occurred mostly below 650 km and that occurrences at greater heights were sporadic. (auth)

10708 ON THE MEAN TEMPORAL VARIATIONS OF ELECTRON DENSITY AT A FIXED HEIGHT IN THE F REGION. A. J. Hirsh (Cavendish Lab., Cambridge, Eng.) and R. W. Knecht. J. Geophys. Research, 67: 595-600 (Feb. 1962).

Monthly mean values of electron density at 280 km over Puerto Rico, obtained from ionospheric vertical soundings, were studied for the period Feb. 1959 to Jan. 1960. Results are used in the equation of continuity to deduce a movement term, div (NV). It is suggested that a marked post-sunrise effect might be due to large gradients in the east-west drift velocity. An alternative explanation, which does not appeal to drifts, is discussed. (auth)

10709 EFFECTS ON THE OZONOSPHERE OF THE THERMAL FLUX FROM NUCLEAR DETONATIONS. Irving L. Kofsky (Technical Operations, Inc., Burlington, Mass.). J. Geophys. Research, 67: 739-44(Feb. 1962).

Dissociation of the protective natural atmospheric ozone by the ultraviolet photons emitted from a nuclear burst is considered, and it is concluded that the O_3 in the main ozonosphere (10 to 40 km) re-forms so rapidly that only negligible additional ultraviolet sunlight could be transmitted. However, the O_3 normally present at altitudes above 70 km remains destroyed for several hours; this effect provides a potential test of the hypothesis that the natural hydroxyl airglow is produced by the reaction of ozone and hydrogen atoms. (auth)

10710 SATELLITE OBSERVATIONS OF ELECTRON CONTENT AT THE MAGNETIC EQUATOR. L. J. Blumle and W. J. Ross (Pennsylvania State Univ., University Park). J. Geophys. Research, 67: 896-7(Feb. 1962).

Observations of 54-Mc signals from Transit 4A were made on the magnetic equator near Huancayo, Peru, beginning in September 1960. The weighted mean for the range of integration was 400 km, and the height range was 1000 km. Average results of two quiet-day observations are presented and may be compared with mid-latitude values for the same time. Rotation angle dependence upon magnetic-field geometry is illustrated. (L.N.N.)

10711 ISOTOPIC ANOMALIES OF MOLYBDENUM IN SOME IRON METEORITES. V. Rama Murthy (Univ. of California, San Diego and La Jolla). J. Geophys. Research, 67: 905-7(Feb. 1962).

The isotopic composition of molybdenum from iron meteorites was investigated for general anomalies or anomalies attributable to specific processes that operated in the early history of the meteorites. Results are presented in tabular form; anomalies of up to 7% relative to terrestial molybdenum were found. These anomalies cannot be attributed to contamination effects or to fractionation in the mass spectrometer. They do not appear in all meteorites. No obvious hypotheses for these phenomena are offered. (L.N.N.)

10712 NEUTRON DIFFRACTION STUDY OF ANTIFERROMAGNETISM IN $FeSn_2$. P. K. Iyengar, B. A. Dasannacharya, P. R. Vijayaraghavan, and A. P. Roy (Atomic Energy Establishment, Trombay, India). J. Phys. Soc. Japan, 17: 247-8(Jan. 1962). (In English)

The magnetic structure of iron atoms in the crystal lattice was investigated. Neutron diffraction patterns of $FeSn_2$ at 300 and 400°K and a unit cell diagram are presented. (L.N.N.)

10713 XENON THERMODYNAMIC DIAGRAM. NUCLEONICS DATA SHEET NO. 45. HEAT TRANSFER. Frank Maslan (Brookhaven National Lab., Upton, N. Y.). Nucleonics, 20: No. 3, 53(Mar. 1962).

An enthalpy-entropy diagram is presented over the ranges of 0 to 150°C and 0 to 2800 atm for xenon. The diagram has intersecting lines indicating density, pressure, temperature, enthalpy, and entropy. (N.W.R.)

10714 THE STARK SHIFT OF THE HYPERFINE STRUCTURE OF AN ATOM WITH A $^2S_{1/2}$ GROUND STATE. L. W. Anderson (Univ. of Wisconsin, Madison). Nuovo cimento (10), 22: 936-42(Dec. 1, 1961). (In English)

Energy levels of an atom in a $^2S_{1/2}$ ground state are examined in the presence of an electric field. It is found that the hyperfine structure of the ground state is Stark shifted. This Stark shift is estimated in a crude fashion. The estimate is in reasonable agreement with the experimental result in the case of Cs^{133} where the Stark shift of the hyperfine structure was measured. The g factor of the ground state is not influenced by an electric field. (auth)

10715 CORRELATION THEORY OF STATIONARY ELECTROMAGNETIC FIELDS. PART IV. SECOND ORDER CONSERVATION LAWS. P. Roman (Boston Univ.). Nuovo cimento (10), 22: 1005-11(Dec. 1, 1961). (In English)

By imitating well-known techniques to obtain the energy equation in Maxwell's theory, eight independent higher order conservation laws are found for second order correlation functions associated with stationary random electromagnetic fields. Two further conservation laws are deduced which involve the physically significant energy coherence and flow coherence tensor. (auth)

10716 CONVERGENCE OF THE PERTURBATION EXPANSION IN SOME MODELS OF THE FIELD THEORY. I. Bialynicki-Birula (Univ. of Rochester, N. Y.) and W. M. Frank. Nuovo cimento (10), 22: 1039-42(Dec. 1, 1961). (In English)

It is shown that in a class of models of quantum field theory, the perturbation expansion of the resolvent operator, $(H - z)^{-1}$, converges for all complex z. The class of models consists of all theories with Yukawa coupling in which the vacuum polarization is neglected. The method used is that of comparison with the exactly solvable neutral scalar model. (auth)

10717 HIGH-VOLTAGE GLOW DISCHARGES IN D_2 GAS. I. DIAGNOSTIC MEASUREMENTS. G. W. McClure (Sandia Corp., Albuquerque, N. Mex.). Phys. Rev. 124: 969-82(Nov. 15, 1961).

Pulsed glow discharges in D_2 gas at currents of about 1 amp and voltages in the range 40 to 80 kv are experimentally examined to determine the mass and energy distribution of ions incident on the cathode, the secondary electron emission due to various particles incident on the cathode, the energy spectrum of the electrons incident on the anode, the potential distribution along the glass walls, and the temperature and density of the electrons in the plasma which develops in the anode end of the discharge. Experimental results are discussed together with available cross-section data from the literature to establish the relative importance of the collision processes which contribute to the sustainment of the discharge. Processes peculiar to the extremely high operating potential (not of particular importance in ordinary glow discharges) are shown to assume dominant roles. These include electron backscattering from the anode, ionization of the gas by fast ions and fast neutral atoms, and ionization in the plasma region due to the secondary electrons released from the glass walls. The necessity of a complete revision of the usual theoretical point of view regarding electron ionization in the cathode region of the discharge and in the anode (plasma) region is indicated. (auth)

10718 MEMORY EFFECTS IN IRREVERSIBLE THERMODYNAMICS. Robert Zwanzig (National Bureau of Standards, Washington, D. C.). Phys. Rev. 124: 983-92 (Nov. 15, 1961).

A new generalization of Onsager's theory of irreversible processes is presented. The purpose is to allow for memory effects or causal time behavior, so that the response to a thermodynamic force comes later than the application of the force. This is accomplished by a statistical mechanical derivation of an exact non-Markoffian kinetic equation for the probability distribution in the space of macroscopic state variables. The memory effect in the resulting transport equations is represented by a time convolution of the thermodynamic forces with memory functions. The latter are time-correlation functions in the rates of change of the phase functions corresponding to macroscopic quantities. The resulting transport equations are not restricted to small deviations from thermal equilibrium. Onsager's theory is shown to be the low-frequency limit of our causal theory. (auth)

10719 TRANSIENT BREAKDOWN STUDIES IN HYDROGEN AT LOW VALUES OF E/p. I. Lessin, D. E. Golden, and L. H. Fisher (New York Univ., New York). Phys. Rev. 124: 993-5(Nov. 15, 1961).

Formative time lag measurements of uniform field breakdown were carried out in hydrogen for products of pressure p and electrode separation d ranging from 100 to 1300 cm × mm Hg. This pd range corresponds to a region of electric field strength E divided by p at the breakdown threshold of 21 to 32 v $(cm\ mm\ Hg)^{-1}$. The formative time lags decrease from about 50 μsec at several hundredths of a percent overvoltage to fractions of a microsecond for overvoltages greater than 5%. The results indicate that the secondary mechanism active is photoelectric emission from the cathode. (auth)

10720 FIELD EMISSION FROM NIOBIUM IN THE NORMAL AND SUPERCONDUCTING STATES. Ralph Klein and Lewis B. Leder (National Bureau of Standards, Washington, D. C.). Phys. Rev. 124: 1050-2(Nov. 15, 1961).

The change of field emission current from a superconductor as a result of a transition to the normal state under constant field and temperature conditions was calculated. The derivation is based on the Bardeen-Cooper-Schrieffer formulation of the density of states and band gap model for a superconductor. The experimental method for determining the current change consisted in measuring the current increment between a niobium field emitter in the superconducting state at 4.2°K and in the normal state at a temperature T above the transition. After correcting for the current increase occurring as a result of the temperature increase alone, the residual would be that associated with the superconducting-normal transition. This was less than the detectability of the measurements, although the calculations indicated an expected increase in current easily measurable if the superconducting-normal transition had occurred at the emitter surface. It is speculated that under high-field conditions, the superconducting state is quenched at the surface. (auth)

10721 ANISOTROPIC BROADENING OF LINEWIDTH IN THE PARAMAGNETIC RESONANCE SPECTRA OF MAGNETICALLY DILUTE CRYSTALS. D. Shaltiel (Israel Inst. of Tech., Haifa), and W. Low. Phys. Rev. 124: 1062-7(Nov. 15, 1961).

The effects of mosaic structure on the anisotropic broadening of the linewidth in paramagnetic resonance spectra of dilute crystals are investigated. A general formula for the line shape and the linewidth at half maximum is derived. The half-width of the spectrum of Gd^{3+} in the single crystal of ThO_2 is measured as a function of the angle of the magnetic field with respect to the cubic

axes. Agreement with theory is found. The average deviation of the crystallites from the symmetry axis is found to be about 0.12°. Small deviations from the agreement indicate a compensating defect approximately along the [100] direction which gives rise to a small axial distortion. (auth)

10722 SPIN-ECHO MEASUREMENT OF THE SPIN-LATTICE AND SPIN-SPIN RELAXATION IN Ce^{3+} IN LANTHANUM MAGNESIUM NITRATE. J. A. Cowen and D. E. Kaplan (Lockheed Research Labs., Palo Alto, Calif.). Phys. Rev. 124: 1098-1101(Nov. 15, 1961).

Fast-resolution time-pulsed microwave apparatus was used to measure the spin-spin and spin-lattice relaxation in Ce^{3+} in lanthanum magnesium nitrate by spin-echo techniques. T_1, measured by a three-pulse sequence, varies as $T_1 = 6 \times 10^{-10} \exp(34/T)$ over a range of four orders of magnitude from 4 to 1.8°K but changes less rapidly below this temperature. T_2, measured by the decay of the echo following a two-pulse sequence, is approximately 1 μsec at 1.4°K and drops very rapidly above 3°K. The accuracy of the numerical values does not seem to be seriously affected by spectral diffusion within the line, but the echo envelope exhibits a strinking amplitude modulation which we attribute to surrounding nuclear moments which makes accurate determination of T_2 quite difficult. (auth)

10723 RELATIVISTIC L-SHELL PHOTOEFFECT. Mihai Gavrila (Parhon Univ., Bucharest). Phys. Rev. 124: 1132-41(Nov. 15, 1961).

Expressions of the relativistic L shell photoeffect differential and total cross sections for light elements are established. Coulomb wave functions are used for the description of the electron states in the calculation of the matrix elements, but it is shown how the results should be corrected so as to take screening effects into consideration. For the final continuum state wave function of the ejected electron, whose exact analytic form is not known, the Born approximation is used. In the case of L_I subshell the calculation runs similarly to the one performed for the K shell. For the other two subshells, new tedious trace evaluations are carried out. Thus, for the L_I subshell, cross sections correct to first order in αZ (inclusive) are determined, whereas in the case of the L_{II} and L_{III} subshells, only their zero-order approximation is calculated. The cross sections are discussed and compared. It is shown that they reduce in the nonrelativistic and extreme relativistic limits to results established by other means. (auth)

10724 ANALYTICAL HARTREE-FOCK SELF-CONSISTENT-FIELD WAVE FUNCTIONS FOR SOME $1s^1 2s^1 2p^6$ CONFIGURATIONS. Lester M. Sachs (Argonne National Lab., Ill. and Illinois Inst. of Tech., Chicago). Phys. Rev. 124: 1283-9(Nov. 15, 1961).

Analytical Hartree-Fock self-consistent-field solutions were obtained by matrix methods for the ten-electron systems F^-, Ne, and Na^+. Solutions were obtained for the F^- and Na^+ ions in the presence of a superposed potential sphere. Tables of the two goodness functions, $f(r) = FR - \epsilon R$ and $g(r) = FR/\epsilon R$, and expectation values of r_i and r_i^2 are given. The diamagnetic susceptibility was calculated for all the systems reported. (auth)

10725 OBSERVATION OF TORQUE EXERTED BY PURE SUPERFLOW. Thomas R. Koehler and John R. Pellam (California Inst. of Tech., Pasadena). Phys. Rev., 125: 791-4(Feb. 1, 1962).

Pure superflow is observed to exert a torque in flowing about an object of arbitrary shape. The magnitude of such torque agrees in every respect with expectations based on pure potential flow theory. Results indicating pure potential flow for superfluid are considered to constitute the complementary experiment to the earlier Craig-Pellam investigation of zero lift for superflow. The two experiments taken together establish completely the pure potential flow property for superfluid by verifying that zero force, but a prescribed torque is exerted upon an object of arbitrary shape and orientation. An independent evaluation of ρ_s/ρ for liquid helium is obtained in conformity with earlier measurements. (auth)

10726 TEMPERATURE DEPENDENCE OF THE SURFACE TENSION OF He II. A. D. Singh (Univ. of Delhi). Phys. Rev., 125: 802(Feb. 1, 1962).

It is shown that the temperature dependence of the surface tension of liquid helium II can be understood on the ideal gas model for the liquid also, provided the eigenfunctions are re-enumerated in a bounded continuum taking into account the surface term. The maximum deviation of the results from experimental ones is about 7%, and from theoretical calculations, about 2%. (auth)

10727 FAST NEUTRAL PARTICLES FROM ARC CATHODE. A. von Engel and K. W. Arnold (Oxford Univ.). Phys. Rev., 125: 803-4(Feb. 1, 1962).

The rotating drum method was used to measure the velocity distribution in the vapor jet emerging from the cathode region in a magnetically stabilized high-vacuum arc discharge maintained between cooled copper electrodes. To obtain sufficient detection sensitivity, part of the cathode was made of radioactive copper. The number distribution of copper atoms deposited on the drum as a function of velocity perpendicular to the surface was measured using a Geiger-Muller counter. An average of about 4×10^4 cm/sec was found for the atomic beam velocity. It is suggested that misinterpretation of earlier observations leads to apparent velocities of up to 10^6 cm/sec. (auth)

10728 HARDNESS OF NONMETALLIC SOLIDS ON AN ATOMIC BASIS. Johannes N. Plendl and Peter J. Gielisse (Air Force Cambridge Research Labs., Bedford, Mass.). Phys. Rev., 125: 828-32(Feb. 1, 1962).

Hardness values of 65 nonmetallic crystalline solids of 16 different structures are compared with data of a newly introduced concept: "the volumetric lattice energy." When such solids are classified according to a new interpretation of lattice anharmonicity, a set of linear interrelations is obtained covering the entire hardness range. Thus, on the basis of interatomic cohesive forces, the over-all hardness of these solids becomes unambiguously defined. Hardness receives the dimension (ergs/cm^3) or (kcal/cm^3), and an absolute scale. Such hardness data become independent of anisotropy, structure type, and valency of the atoms. Conversion from relative to absolute hardness, as well as estimation of lattice energy data through appropriate hardness testing, becomes possible. (auth)

10729 ELASTIC SCATTERING IN THE N–N, C–N, AND C–C SYSTEMS. A. M. Smith and F. E. Steigert (Yale Univ., New Haven). Phys. Rev., 125: 988-91(Feb. 1, 1962).

Differential cross sections were measured for the elastic scattering of N^{14} from C^{12}, N^{14} from N^{14}, and C^{12} from C^{12} to a relative precision of about 5%, and an absolute accuracy of 15%. Incident energies of nominally 10 Mev/amu were employed, and an angular range was covered from about 4 to 24° in the center-of-mass system. The use of solid-state detectors rendered energy resolution of the order of 1.5%. Theoretical cross sections calculated from both the simple-diffraction model and the sharp-cutoff model were fitted to the experimental data, giving interaction radii for

the three reactions of 6.44, 6.68, and 6.23 fermi, respectively. (auth)

10730 SPECTRAL MOMENTS AND CONTINUUM PERTURBATION THEORY. E. O. Kane (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Rev., 125: 1094-9(Feb. 1, 1962).

The pth spectral moment is shown to be given exactly by the perturbation expansion of the resolvent operator carried to order p. Any individual term of order n in the perturbation expansion makes an identically zero contribution to the pth moment for n greater than p. This is true even though perturbation theory is nonconvergent. The result may be useful where perturbation theory converges for high but not for low energy. An application to the problem of band structure "tails" in impure crystals is suggested. (auth)

10731 ANOMALOUS ELECTRON MOBILITY AND COMPLEX NEGATIVE ION FORMATION IN LOW-TEMPERATURE HELIUM VAPOR. James Levine and T. M. Sanders, Jr. (Univ. of Minnesota, Minneapolis). Phys. Rev. Letters, 8: 159-61(Feb. 15, 1962).

Experimental evidence that slow electrons injected into helium vapor do not travel between collisions as free electrons but form heavy complexes with helium atoms was obtained from mobility data. A mobility four orders of magnitude lower than expected from kinetic theory assuming free electrons was observed in the saturated vapor. The mobility rises rapidly as the gas pressure is lowered below the saturated vapor pressure. It is interpretable in terms of a thermodynamic instability of the complex, but is not consistent with the possibility of observing the transport of an impurity negative ion. (L.N.N.)

10732 DETECTION OF THIRD SOUND IN LIQUID HELIUM FILMS. C. W. F. Everitt, K. R. Atkins, and A. Denenstein (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Letters, 8: 161-3(Feb. 15, 1962).

A third sound was detected in thin films of liquid helium II. It appears as an oscillation in the thickness of the film, and the predicted velocity is about 50 cm/sec. Velocity variations with film height were measured. Temperature effects were measured at up to 2°K. The velocity and amplitude of third-sound decrease with increasing temperatures is in qualitative agreement with theory. Since the velocity is comparable with the film transfer critical velocity, it is suggested that the sudden onset of dissipation at the critical velocity arises from third-sound quanta creation. (L.N.N.)

10733 α-β PHASE TRANSITION OF SOLID He^3. Newton Bernardes (Ames Lab., Ames, Iowa). Phys. Rev. Letters, 8: 164-5(Feb. 15, 1962). (IS-389)

Stability of the body-centered cubic phase with respect to the face-centered cubic is investigated. Relations among variables of the phase transition are sought. Discrepancies were found and the problem of relative stability of body-centered cubic and the hexagonal prism lattices remains unsolved. (L.N.N.)

10734 ANOMALOUS RESISTIVITY OF DILUTE MAGNESIUM–NEODYMIUM ALLOYS. S. B. Das and A. N. Gerritsen (Purdue Univ., Lafayette, Ind.). Phys. Rev. Letters, 8: 169(Feb. 15, 1962).

Temperature dependence of the extra resistivity $\Delta\rho_T$ due to the alloying was investigated. Agreement with previous results (E. I. Salkovitz et al., Phys. Rev., 105: 887(1957)) was obtained. Measurements at 4.2 and 77 to 230°K were then performed and deviations were obtained; $\Delta\rho_T$ decreased with temperature, in violation of Matthiessen's rule that $\Delta\rho$ be independent of temperature. The ratio $\Delta\rho_T/\Delta\rho_{273}$ was plotted against $1/T$ at $77 \leq T \leq 273°$. For neodymium impurities, the temperature-dependent part in $\Delta\rho_T$ seems much larger. (L.N.N.)

10735 DETECTION OF NUCLEAR SPIN STATES IN MOLECULAR CRYSTALS. M. Bloom and E. P. Jones (Univ. of British Columbia, Vancouver). Phys. Rev. Letters, 8: 170-1(Feb. 15, 1962).

Low-temperature proton magnetic resonance experiments on C_2H_2 and H_2O are described. Possibilities that observed time dependences of neutron scattering cross sections are associated with time constants for spontaneous conversion of proton pairs in these compounds from ortho to para configurations are eliminated. (L.N.N.)

10736 SELF-CONSISTENT FIELD CALCULATION WITH CORE APPROXIMATION ON BeH. Asish Kumar Chandra (Univ. Coll. of Science and Tech., Calcutta). Proc. Natl. Inst. Sci. India. Pt. A, 27: 258-62(July 26, 1961). (In English)

Self consistent field calculation with core approximation on BeH^+ shows that although the approximation is effective in giving a general picture of the electronic structure of a diatomic hydride, absolute agreement between the calculated and the experimental results is not obtained. (auth)

10737 HELMHOLTZ INSTABILITY IN HYDROMAGNETICS. S. P. Talwar (Univ. of Delhi). Proc. Natl. Inst. Sci. India. Pt. A, 27: 263-9(July 26, 1961). (In English)

The stability of a configuration of two superposed perfectly conducting liquids in relative tangential motion is investigated under the influence of ambient parallel magnetic fields. It is found that the presence of a current sheet improves the stability of a vortex sheet. The analysis is further extended to study the motion of a liquid jet. (auth)

10738 THE STUDY OF THOMSON SCATTERING COEFFICIENT IN DEGENERATE SYSTEMS. M. P. Kawatra and K. K. Bajaj (Univ. of Delhi). Proc. Natl. Inst. Sci. India. Pt. A, 27: 305-16(July 26, 1961). (In English)

The distribution of electrons belonging to an ionized system depends upon the collective long-range interactions and the extent of degeneracy. As the charge density can be expressed in terms of spatial Fourier components, it is seen that at finite temperatures the components of low wave numbers are suppressed whereas those of larger wave numbers remain unaffected thus leading to partial ordering. The extent of partial ordering depends upon the degree of degeneracy, i.e. higher the degeneracy lesser is the ordering. The effect of this partial ordering caused by long range interactions and the modification produced by degeneracy is considered while calculating the Thomson's Scattering coefficient. This modified scattering coefficient changes the values of radiative opacity significantly in the two stellar systems considered. (auth)

10739 EXPERIMENTS BY RADIOACTIVE TRACER METHODS ON SPUTTERING BY RARE-GAS IONS. H. Patterson and D. H. Tomlin (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng. and Univ. of Reading, Eng.). Proc. Roy. Soc. (London), A265: 474-88(Feb. 6, 1962).

By incorporating the radioactive isotope Au^{198} either homogeneously or in specific layers parallel to the surface in plane, polycrystalline gold targets, it was possible to investigate the angular distributions of particles ejected in the sputtering process induced by bombardment with Ar^+ and Kr^+ ions in the energy range 5 to 10 kev, and also to study the ejection of particles from different depths below the surface of the target. Compared with a cosine-law representation, the angular distributions were found to be more strongly peaked in the direction of the target normal. This departure from the cosine law was found: to decrease

with decreasing ion energy; to be smaller for Kr^+ ions than for Ar^+ ions of the same energy; and to decrease when the Au^{198} was restricted to thin surface layers. These results show systematic behavior with respect to the penetration range of the incident ions and are consistent with the view that the sputtering process includes the ejection of atoms from finite depths, resulting in some degree of collimation along the target normal. Direct experimental verification of this conclusion was sought by the use of subsurface layers of Au^{198}. With Ar^+ ions of 8 kev energy a significantly positive result was obtained, but the depth involved with Kr^+ ions of the same energy was much smaller. The maximum depths from which Au atoms were ejected by Ar^+ and Kr^+ ions of this energy were found to correspond reasonably with calculated ion ranges. The experiments showed that in the sputtering process, atoms are ejected instantaneously from depths of several atomic diameters. (auth)

10740 CHARACTERISTICS OF THE SPECIAL SPARK-GAP POSSESSING PROTRUDING NEEDLE. Yoshitane Ishiguro and Tomiyuki Ushita (Tokushima Univ., Japan). Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: 207-16(Dec. 1961). (In English)

The special spark gap consists of a sphere gap, one of its electrodes possessing a small projection at the center. The behavior of this gap is investigated by measuring sparkover voltages in air under impulsive as well as direct voltage, with and without irradiation from ultraviolet light source or radioactive material. The irradiation lowered the sparkover voltage as much as 60%. The phenomenon of this extremely large voltage lowering may be realized due to irradiation by changing nearly uniform sphere gap to extremely non-uniform needle-to-plane gap. The cause of this phenomenon may be attributed to the photoelectric effect in air coupled with partial breakdown which would readily satisfy the condition to increase the probability of advancing positive streamer to grow out of the needle tip to accomplish sparkover. (auth)

10741 THE EFFECT OF ISOSTRUCTURES ON THE SPECTRA OF ACTIVATED MIXED CRYSTALS. F. D. Klement and L. A. Teiss. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 14, 76-86(1961). (In Russian)

Alkali halide and ammonium halide mixed crystalline phosphors were investigated. It was found that such phosphors, when excited in different parts of the excitation band, exhibit emission bands displaced in relation to one another. This effect is connected with the existence of isostructures of different composition in mixed crystals. It was established that the thallium-type activator is concentrated chiefly in the isostructures containing the largest number of heavier anions. A displacement of emission bands toward shorter wave-lengths revealed itself as the activator concentration was increased. This is a result of the successive occupying of isostructures with an ever smaller content of heavy anions. (auth)

10742 CONCENTRATION BEHAVIOUR OF SPECTRA AND QUANTUM EFFICIENCY IN ALKALI HALIDE PHOSPHORS ACTIVATED BY SILVER. R. G. Lushpa and L. A. Rebane. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 14, 87-110(1961). (In Russian)

Absorption, emission, and excitation spectra of the phosphors NaBr–Ag, NaCl–Ag, and KCl–Ag were studied in a broad range of activator concentrations. On the basis of observed changes of spectral characteristics, the conclusion was drawn that in these phosphors there exist several kinds of activator luminescence centers (centers I, II, and III). Concentration behavior of quantum efficiency was investigated for different excitation wave-lengths, giving rise to different degrees of excitation in centers of one or another nature. Results are discussed. (auth)

10743 SPECTROSCOPY OF LUMINESCENCE CENTRES OF IONIC CRYSTALS ACTIVATED BY THE NOBLE IONS (Cu^+, Ag^+, Au^+). N. E. Lushchik and S. G. Zazubovich. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 14, 141-67(1961). (In Russian)

Spectral characteristics of KBr- and KCl-phorphors activated by copper, silver, and gold are examined. A comparison is made of the luminescence centers in crystals with each activator. The nature of the luminescence centers is discussed. (auth)

10744 ON THE ROLE OF GRAIN BOUNDARIES AND DISLOCATIONS IN THE LUMINESCENCE OF ACTIVATED ALKALI HALIDE CRYSTALS. R. I. Gindina. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 14, 168-89 (1961). (In Russian)

A microscopic investigation was made of the emission topography of alkali halide crystals. The effect of thermal treatment and defects, generated by plastic deformation or by x-irradiation and subsequent bleaching, on the formation of luminescence centers in alkali halide crystals was examined. It was concluded that the luminescence of typical alkali halide phosphors is not connected with the activator particles that are situated on the boundaries of grains whose dimensions are 0.1 to 0.01 mm. Most of the luminescence centers evidently correspond to the activator ions in substitutional sites, and the more complex centers correspond to the activator ions in clusters with point defects of the lattice. (auth)

10745 PHYSICAL PROCESSES IN AMMONIUM HALIDE CRYSTALS. Ch. B. Lushchik and L. Ya. Uibo. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 14, 190-211(1961). (In Russian)

Comparison of excitation, electron, hole, and vibrational processes in alkali halide and ammonium halide crystals was carried out. It was concluded that physical phenomena affecting preferably the anion sublattice of these crystals are analogous, whereas processes which proceed in the cation sub-lattice of the crystals are very different owing to specific features of NH_4^+ ions. Special attention was given to the complicated luminescence mechanism of ammonium halide crystalphosphors. (auth)

10746 THE EFFECT OF THE INTENSITY OF EXCITATION AND TEMPERATURE ON THE STATIONARY INTENSITY OF LUMINESCENCE OF ZnS PHOSPHORS. K. -S. K. Rebane. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 14, 260-9(1961). (In Russian)

The band model of luminescence in a stationary state having two systems of electron traps and one system of hole traps is discussed. It is supposed that the number of hole traps is much smaller than the number of electron traps. It is also proposed that the number of electrons in the conduction band and the number of holes in the valence band are much smaller than the number of trapped electrons and holes. On this basis are obtained formulas for calculating the number of ionized centers of luminescence–n and the number of electrons in the conduction band. A formula is also obtained for calculating temperature dependence of quantum yield of luminescence. It is shown that the power of superlinearity for luminescence 3 and for photoconductivity – 2 may be expected on the basis of these formulas. (auth)

10747 ON THE INTERACTION MECHANISM OF EXCITATIONS WITH Tl^+ CENTRES IN KI–Tl. G. G.

Liidya. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 14, 272-5(1961). (In Russian)

The KI–Tl phosphor emission spectra at various excitation wave lengths and stationary luminescence excitation spectra for various emission bands were measured at 120°K with two-quartz monochromators in order to determine the excitation induced luminescence mechanism. (R.V.J.)

10748 ON THE RELATION OF X-RAY AND γ-LUMINESCENCE YIELD AND CHARGE LOCALISATION IN KI–Tl. T. A. Soovik. Trudy Inst. Fiz. i Astron., Akad. Nauk Eston. S.S.R., No. 14, 281-5(1961). (In Russian)

The effects of 100 to 270°K temperature on KI–Tl x- and γ-luminescence yields are studied. (R.V.J.)

10749 INVESTIGATIONS ON THE BALMER SPECTRA IN A HIGH FREQUENCY DISCHARGE. H. Schlueter (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 972-84(Oct. 1961). (In German)

With an rf-discharge, an extremely clean Balmer spectrum is obtained having a line melting at the principal quantum number 20. Electron temperature, gas temperature, and electron density are determined. The ionization-recombination balance is considered with a modified form of the Corona-ionization formula. (auth)

10750 MASS SPECTROMETRIC MEASUREMENT OF THE ISOTOPIC FREQUENCY OF POTASSIUM FROM IRON METEORITES AND THE PROBLEMS OF THE DETERMINATION OF THE $K^{41}-K^{40}$ RADIATION AGE. H. Voshage and H. Hintenberger (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 16a: 1042-53(Oct. 1961). (In German)

In 11 iron meteorites the isotopic abundances of potassium were measured. For some meteorites mass spectra of essentially potassium were obtained for example, from Aroos K^{39} 42.0%; K^{40} 18.9%; K^{41} 39.1%. In other meteorites (e.g. Lombard K^{39} 88.0%, K^{40} 2.1%, K^{41} 9.9%) the primordial potassium predominates. From the isotopic abundances, the radiation ages of the iron meteorites were calculated from two different approaches: in the first case under the assumption that the potassium isotopes were produced in the same proportion in all meteorites; in the second case it was assumed that the energy spectrum of the radiation and hence the production ratios of the potassium isotopes differed from meteorite to meteorite. The He/Ne-ratios in the meteorites were taken to be characteristic of the nature of the energy spectrum. Since the relationship between the He/Ne ratio and the production ratios for the potassium isotopes is not yet well known the calculated radiation ages are probably only approximately correct. They vary between 1400×10^6 years (Clark County) and 200×10^6 years (Lombard). (auth)

10751 CONTRIBUTION TO THE DATING OF IRON METEORITES BY THE RHENIUM–OSMIUM METHOD. W. Herr (Universität, Cologne and Max-Planck-Institut für Chemie, Mainz), W. Hoffmeister, B. Hirt, J. Geiss, and F. G. Houtermans. Z. Naturforsch., 16a: 1053-8 (Oct. 1961). (In German)

The rhenium and osmium contents and the isotopic compositions of osmium in a number of meteorites were measured. Os/Re ratios and Os^{187}/Os^{186} ratios vary sufficiently to make the Re^{187}/Os^{187} dating-method applicable to meteorites. Also, the isotopic compositions of several samples of common terrestrial osmium were determined, giving variations in the Os^{187}/Os^{186} ratio which are larger than the common terrestrial strontium variations. The half life of Re^{187} still is only tentatively known. Taking the latest value (4.3×10^{10} years), it is shown that the results are in agreement with the assumption that stone meteorites, iron meteorites, and the crust of the earth were formed about 4 to 5 AE ago. (auth)

10752 THE RADIATION INTENSITY OF AN ENERGETIC FLARE DISCHARGE BETWEEN 1250 AND 1340 Å. K. D. Bayes, K. H. Becker, and Karl H. Welge (Universität, Bonn). Z. Naturforsch., 16a: 1089-90(Oct. 1961). (In German)

Measurements on the radiation intensity of flare discharges at discharge energies up to 1400 joules and discharge times of several microseconds were made between 1250 and 1340 Å. The experimental arrangement is described, and the results are given and discussed. The studies were made with nitrogen and hydrogen at a pressure of 6 Torr in the discharge chamber. (J.S.R.)

10753 MASS SPECTROMETRIC INVESTIGATION OF THE PHOTOIONIZATION OF ARGON. E. Schoenheit (Freie Universität, Berlin). Z. Naturforsch., 16a: 1094-6(Oct. 1961). (In German)

The mass-spectrometric study of the photoionization of gases was extended with the measurement of the effective cross section of argon as a function of the wave length in the range from 410 to 802 Å. The experimental conditions are described. The determination of the effective cross section was made by the method of constantly standardized wave length and simultaneous registration of both multiplier currents over a long period. The results of several series of measurements are shown graphically as a function of the wave length. (tr-auth)

10754 THE LUMINESCENCE OF CdS SINGLE CRYSTALS. H. Friedrich (Physikalisch-Technisches Institut, Deutsche Akademie der Wissenschaften, Berlin). Z. Naturforsch., 16a: 1106-7(Oct. 1961). (In German)

The production and intensification of the green and red luminescence observed in the optical excitation of CdS single crystals at low temperatures has been previously reported. It appeared possible that an intensification of the blue luminescence appeared possible. At 80°K the blue luminescence and a weak red luminescence was detectable. In all the crystals studied, the emission of the blue band increased in the range from 4850 to 5000 Å, and then the crystal surface was exposed to a glow discharge. The intensities of the luminescence before and after glowing were tabulated. Corresponding measurements after multiple glowings show that the intensity reaches a maximum after the fourth glowing. The spectral distribution of the blue luminescence perpendicular and parallel to the c axis is shown for one of the crystals studied. (J.S.R.)

10755 QUALITATIVE TESTING OF THE FLUORESCENT CHANGE OF ORGANIC SOLUTIONS AFTER THE ACTION OF ULTRAVIOLET LIGHT. Wilhelm Ludwig and Lieselott Herforth (Technische Hochschule, Merseburg, Ger.). Z. Naturforsch., 16b, 638-44(Oct. 1961). (In German)

The qualitative visual testing of the fluorescent behavior of over 70 chiefly visibly fluorescing organic compounds in various solvents was described after irradiation with ultraviolet light. The survey given serves as a basis for the quantitative investigations of the temporal fluorescent pattern under radioactive and UV irradiation with relatively low doses and of some chemical processes induced by the radiation. (tr-auth)

10756 THE STATISTICAL THERMODYNAMICS OF IDEAL GASES WITH ISOTOPE-SUBSTITUTED MOLECULES. G. Vojta (Arbeitsstelle für Statistische Physik,

Leipzig and Deutschen Akademie der Wissenschaften, Berlin). Z. physik. Chem. (Leipzig), 217: 337-52(1961). (In German)

New formulas for reduced partial function ratios $(s/s')f$ and differences of thermodynamic functions were established for isotopic substituted molecules and discussed with practical examples. For $\ln((s/s')f)$ an infinite series by powers of Δu_i was derived [$\Delta u_i = hc/kT \times$ (difference of the i^{th} normal oscillation frequency of two isotopic substituted molecules)], which represents an expansion of the basic formula of Bigeleisen and Goeppert-Mayer (1947) and is convergent for all occurring values of u_i and Δu_i, i.e., also for high frequencies and low temperatures. Expanded series for the reduced differences of the thermodynamic functions were also developed. An investigation of the accuracy of the formulas for $(s/s')f$ was made on the basis of molecules with C and S isotopes. With the help of the spectroscopic sum rule of the 1st order, the formulation of relations between reduced partial function ratios and reduced differences of thermodynamic functions was made for multiply isotopic substituted molecules. Simple formulas for the inharmonious corrector of the oscillations are given, and the effect of this corrector was investigated. (tr-auth)

10757 PROCEEDINGS [OF THE] 15th ANNUAL POWER SOURCES CONFERENCE, 9-11 MAY 1961. Red Bank, N. J., PSC Publications Committee, [1961]. 167p.

Thirty-seven papers are included; separate abstracts have been prepared for seven. The information presented is concerned primarily with the research and development work being accomplished in the fields of primary fuel cell batteries, regenerative fuel cell batteries, secondary batteries, primary batteries, solar energy conversion, and thermal energy conversion. The theories and equipment developed are described in terms of use and operation. (N.W.R.)

10758 BEHAVIOUR OF MODIFIED RADIATION-RESISTANT SOLAR CELLS. J. Mandelkorn, C. McAfee, J. Kesperis, L. Schwartz, and W. Pharo (U. S. Army Signal Research & Development Lab., Fort Monmouth, N. J.). p.102-5 of "Proceedings [of the] 15th Annual Power Sources Conference, 9-11 May 1961." Red Bank, N. J., PSC Publications Committee.

A study is made of the radiation resistance of a modified phosphorus-diffused solar cell. The over-all investigation revealed that high-efficiency cells with improved collection, low "A" values, and low reverse currents can be consistently fabricated by diffusion in the 850 to 1000°C range. At the lower temperature limit, significant improvement in "blue" collection is obtained at the expense of higher sheet resistance. The chief limitation encountered in terms of attainment of efficiencies in the 14% and higher range was the comparatively poor lifetime in the one-ohm-cm material grown at USASRDL. High-efficiency cells can be obtained with material in the ten-ohm-cm range for the reason that the higher lifetime in such material is preserved by the process to yield high short-circuit currents. The higher short-circuit current offsets the loss in open-circuit voltage because of the Fermi Level in the ten-ohm-cm material. Thus, high-efficiency cells can be made by 875°C diffusion into high resistivity-base material and such cells have considerably improved radiation resistance and hitherto unrealized high short wavelength collection. (N.W.R.)

10759 RECENT ADVANCE IN THERMAL ENERGY CONVERSION. David C. White, Bruce D. Wedlock, and John Blair (Massachusetts Inst. of Tech., Cambridge). p.125-32 of "Proceedings [of the] 15th Annual Power Sources Conference, 9-11 May 1961." Red Bank, N. J., PSC Publications Committee.

The methods and equipment used to convert thermal energy into electric energy are discussed in terms of the development and research progress being accomplished. Thermal electric converters have the common property of using electron gas as a thermodynamic working fluid. The information discussed here is concerned with thermoelectric conversion, thermionic conversion, magnetohydrodynamic generation, solar photovoltaic conversion, and thermal-photovoltaic conversion. Emphasis is placed on the efficiency of the converters, properties of thermoelectric materials, and operation and performance of the converters. (N.W.R.)

10760 THE ISTHMUS EFFECT—A NEW THERMOELECTRIC PHENOMENA. Gunmar A. F. Winckler and Richard C. Evans (Olin Mathieson Chemical Corp., New Haven). p.132-4 of "Proceedings [of the] 15th Annual Power Sources Conference, 9-11 May 1961." Red Bank, N. J., PSC Publications Committee.

When a large number of metal couples having appreciable cross sections are used in thermoelectric generators, it is difficult to maintain a temperature difference between hot and cold junctions and therefore the usefulness of the metallic thermoelement in power generation is impeded. The solution to the heat transfer problem is to slit the metal couples transversely until nearly severed or to fold back the metal so that only a spot or several spots can be spot welded. The thermal conductivity of the material is decreased to a greater extent than the electric conductivity. The electric resistance and equilibrium temperature difference between hot and cold junction are compared with and without such thermal barriers. The electrical resistance is shown to increase by 35% while the temperature difference is increased 230% for an approximately constant heat source. (N.W.R.)

10761 CRYOGENIC FUELED THERMOELECTRIC GENERATORS. J. Angello and W. Shorr (U. S. Army Signal Research & Development Lab., Fort Monmouth, N. J.). p. 134-9 of "Proceedings [of the] 15th Annual Power Sources Conference, 9-11 May 1961." Red Bank, N. J., PSC Publications Committee.

The use of a cryogenic fuel as an energy source to generate electrical power shows great promise as verified by the results obtained from initial experiments on a single thermocouple operated with liquid nitrogen. The generator produced 875 milliwatts output power from the single thermocouple at a temperature difference of only 126°C. The thermodynamic properties of various cryogenic fuels (liquefied gases) are given along with their index of performance for use in the generators. Considerations for a possible design of a thermoelectric generator using cryogenic fuel are pointed out and the properties and performance of various thermocouples are given for these considerations. (N.W.R.)

10762 A 500 WATT THERMOELECTRIC GENERATOR DESIGN. W. C. Moreland (Westinghouse Electric Corp., Pittsburgh). p.139-42 of "Proceedings [of the] 15th Annual Power Sources Conference, 9-11 May 1961." Red Bank, N. J., PSC Publications Committee.

The basic design features, capabilities, and performance of air cooled thermoelectric generators are described. The generators discussed are built with thermocouples which have an effective thermoelectric figure of merit of approximately 1×10^{-3} per °C over the temperature range 100 to 550°C. Both sealed free convection cooled and unsealed forced convection cooled thermoelectric generators

are described. Particular emphasis is placed on weight and efficiency rather than cost. (N.W.R.)

10763 THERMIONIC CONVERTERS—DESIGN STATUS AND FORECAST. E. A. Baum and A. O. Jensen (General Electric Co., Schenectady, N. Y.). p.143-8 of "Proceedings [of the] 15th Annual Power Sources Conference, 9-11 May 1961." Red Bank, N. J., PSC Publications Committee.

The power characteristics, operation, performance, and practical aspects of sealed-off, production-type vacuum and vapor thermionic converters are discussed. Emphasis is placed on arc-mode vapor thermionic converters operating with cathode temperatures of about 1500°C and below and on vacuum converters operating with cathode temperatures of 1000 to 1200°C. Comparisons are made between the two types with respect to power output, efficiency, cathode temperatures, anode temperatures, variation in power output density as a function of electrode spacing, and energy level diagrams. (N.W.R.)

10764 THE PLASMA TRIODE—A LOW TEMPERATURE THERMIONIC CONVERTER. W. B. Hall (Radio Corp. of America, Lancaster, Penna.) and K. G. Hernqvist. p.148-50 of "Proceedings [of the] 15th Annual Power Sources Conference, 9-11 May 1961." Red Bank, N. J., PSC Publications Committee.

The requirements, circuit system, operation, performance, and theory of plasma triode-type thermionic energy converters are discussed. The triode is used for heat source temperatures in the range 1000 to 1300°C, where cathode work functions of the order of 2 volts are called for in order to obtain reasonably high efficiencies. The third electrode generates ions into the interelectrode space for space charge neutralization. Information is given on the anode current with respect to ion emitter temperature for ion emitter materials, collector current versus bias voltage, and collector current and power output versus voltage. (N.W.R.)

10765 EXPLODING WIRES. William G. Chace and Howard K. Moore, eds. Based on Conference on the Exploding Wire Phenomenon, April 1959. New York, Plenum Press, Inc., 1959. 373p.

Twenty-six papers are included on theoretical and experimental studies of exploding wire phenomena. Applications of exploding wires and techniques employed in their study are also considered. Separate abstracts have been prepared for three papers related to thermonuclear research. Four papers were previously abstracted in NSA. (D.E.B.)

10766 THE CURRENT PAUSE IN AN EXPLODING WIRE. R. J. Reithel, J. H. Blackburn, G. E. Seay, and S. Skolnick (Los Alamos Scientific Lab., N. Mex.). p.19-23 of "Exploding Wires." New York, Plenum Press, Inc., 1959.

Light emitted by a triggered spark gap switch was used to establish a common time base for observations of exploding wire phenomena by a streak camera, a time-resolving spectrograph, and current and voltage oscilloscopes. Data obtained suggested different mechanisms for the explosions in the cases in which the current paused and in which no pause occurred. In the case of the pause, the current appeared to be carried by the unvaporized wire material during the first pulse, and, after the pause, by the vaporized wire material. In the case in which the current did not pause, breakdown occurred in the air around the wire vapor, after which the current path transferred to the gold vapor. (auth)

10767 THE PINCH EFFECT IN THE EXPLODING WIRE PHENOMENON. Jack Katzenstein (Univ. of New Mexico, Albuquerque). p.135-46 of "Exploding Wires." New York, Plenum Press, Inc., 1959.

The attainment of extreme temperatures in the exploding wire should depend upon the degree of confinement by the self-magnetic field, the "pinch effect." The temperature is given by $T = i^2/2NK$, where i is the current in absolute electromagnetic units and N is the number of particles per unit length. This relation can apply either to a discharge through a rarefied gas or through a metallic conductor. If the diameter of the conductor is sufficiently small, the value of N obtainable in either type of experiment is comparable. If the self-magnetic field is to compress the wire without ejecting it from the circuit, it is necessary that the return current be symmetric about the wire. This is accomplished by making the wire the central conductor of a coaxial line. Streak camera photographs and accompanying current wave forms are obtained from such discharges. The wire is of copper 0.002 in. in diameter and either 4 or 1 in. long. The capacitance is 1 μf charged to 30 kv with a ringing frequency of 330 kc. The upper limit for the current is 60,000 amp. The streak camera photographs the wire end-on through a slit in the shorting plate of the coaxial line. The streak camera photographs show a periodic expansion and contraction of the luminous region. The period is the same as the ringing frequency of the circuit and the contractions correspond in time to the current maxima. (auth)

10768 A HIGH-VOLTAGE QUICK-ACTING FUSE TO PROTECT CAPACITOR BANKS. H. Bruce McFarlane (Univ. of California, Livermore). p.324-44 of "Exploding Wires." New York, Plenum Press, Inc., 1959.

A high-voltage fuse designed to protect capacitor banks is described. Design criteria are given and a possible mechanism is theorized. (auth)

10769 INTERMOLECULAR POTENTIALS FROM SCATTERING EXPERIMENTS: RESULTS, APPLICATIONS, AND LIMITATIONS. I. Amdur (Massachusetts Inst. of Tech., Cambridge). p.369-77 of "Progress in International Research on Thermodynamic and Transport Properties." New York, American Society of Mechanical Engineers, 1962.

Theoretical and experimental aspects of high-energy neutral-particle scattering are discussed with reference to the determination of the potential energy of molecular interactions at small internuclear separations, where such information cannot be obtained from measurements of transport or equilibrium properties of gases. Numerical results are given for systems of varying degrees of molecular complexity. Results can be used for calculating transport and equilibrium properties of normal, undissociated gases up to 15000°K, and extensions to systems containing ionic, excited, metastable, or dissociated species are feasible. (auth)

Astrophysics and Cosmology

10770 THE NON-THERMAL RADIATION FROM NGC 4486. R. C. Bless (Univ. of Wisconsin, Madison). Astrophys. J., 135: 187-94 (Jan. 1962).

The color index of the jet of NGC 4486 between λ4350 and λ6300 and the blue magnitude of the jet were found to be $0^m73 \pm 0^m15$ and $14^m1 \pm 0 \pm 3$, respectively. These values were derived by an isophotometric analysis of two 200-in. plates, combined with the intensity distribution and color

index of the galaxy derived by previous workers. The visual continuum is an extension of the non-thermal radio-frequency spectrum with a spectral index of −2.6 compared with the radio spectral index of −0.74, indicating an ultraviolet cutoff of the radiation. The total non-thermal energy radiated by M87 is 5.6×10^{42} ergs/sec, of which about 15% is visual radiation from the jet. On the assumption that this radiation arises by means of the synchrotron mechanism and from other considerations, especially of particle acceleration, a model of M87 is suggested. This model requires a magnetic field of about 10^{-3} gauss in the jet and 10^{-6} gauss in the main body of the galaxy. (auth)

10771 ON THE STABILITY OF IONIZATION FRONTS. Peter O. Vandervoort (Princeton Univ., N. J.). Astrophys. J., 135: 212-34(Jan. 1962).

The stability of a one-dimensional weak D-type ionization front is investigated, in case the perturbations of the neutral gas and ionized gas on the two sides of the front are isothermal. The characteristic value problem governing the complex rates of growth for the unstable modes is formulated, and the solutions for the rates of growth are obtained in the limit that the ratio of the speed of sound in the neutral gas to the speed of sound in the ionized gas tends to zero. If the radiation field associated with the front has no particular symmetry, both overstable and unstable modes occur; if the symmetry of the radiation field is such that the flux through every plane normal to the front vanishes, then all modes are simply unstable. If the radiation field has this symmetry and the condition of the front is D-critical (in the nomenclature of Kahn), the front is stable. However, even small departures of the condition of the front from D-critical will allow a substantial instability. For this reason, the stability of the critical D-type front probably has no important consequences. The physical mechanism for the instability is considered briefly, and it is shown that the instability is related to such well-known processes as the rocket effect of Oort and Spitzer. As a numerical example illustrating the theory, the rates of growth are computed for the instability of the boundary of an H II region illuminated by a star of early spectral type. A conclusion tentatively drawn from this example is that the instability might produce irregularities similar to bright rims and "elephant trunks" in a time comparable to the age of the H II region. (auth)

10772 ELECTRON-POSITRON PAIRS AT VERY HIGH TEMPERATURES. Douglas H. Sampson (Los Alamos Scientific Lab., N. Mex.). Astrophys. J., 135: 261-71 (Jan. 1962).

The effect of the equilibrium concentration of electron-positron pairs on the properties of a star at very high temperatures is investigated. It is found that the stellar masses required are so large that probably the relatively low-density, high-temperature region is never reached where such things as total energy density and pressure are due almost entirely to pairs and radiation. However, many stars are likely to evolve through values of ρ and T for which pairs, though not dominant, are important in determining the properties of a star. (auth)

10773 ON A NEW MECHANISM OF MICROPULSATION OF EARTH'S MAGNETIC FIELD. M. A. Gintsburg (Inst. of Geomagnetism, Ionosphere, and Radiowaves, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 11, 1679-91(1961). (In Russian)

It was found that solar corpuscular fluxes emit magneto-hydrodynamic waves (with 10^{-1} to 10^{-3} c/sec) which produce short-period variations in the Earth's magnetic field. (tr-auth)

10774 MEASUREMENT OF INTERPLANETARY ELECTRON DENSITY FROM THE EARTH. M. J. Buckingham (Univ. of Sydney). Nature, 193: 538-9(Feb. 10, 1962).

The possibility of using radio wave occultation to measure the electron distribution in interplanetary space is discussed. Scattering in the solar corona and measurement of the lunar electron atmosphere are considered. An equation for the angle of deviation of a radio wave arriving at the earth as a function of the electron density at the earth's distance from the sun is derived from a model of the solar wind. (D.L.C.)

10775 FUNDAMENTAL LENGTH, FINE STRUCTURE CONSTANT AND COSMOLOGICAL NUMBER. K. M. Guggenheimer (Glasgow Univ.). Nature, 193: 664-5(Feb. 17, 1962).

The masses of heavy fermions, the excitation energies of the free proton, and the magnetic moments of protons and neutrons can be correlated with the aid of the equation: $E = a[l(l + 1) + s(s + 1)]m_e c^2$ with $a = 75.27$. With these correlations the fundamental length, fine structure constant, and cosmological number are determined. (N.W.R.)

10776 TRANSFINITE NUMBERS AND COSMOLOGY. Richard Schlegel (Michigan State Univ., East Lansing). Nature, 193: 665-6(Feb. 17, 1962).

It is theoretically shown that for physical spaces of the kind normally considered in steady-state cosmology the number of atoms cannot be greater than a simple denumerable infinity. Emphasis is placed on an infinite series of numbers which denotes the atom-spaces in the universe. (N.W.R.)

Cosmic Radiation

10777 NEUTRON PRODUCTION BY UNSTABLE PARTICLES. C. Bercea (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 299-304(1961). (In Rumanian)

A compensation experiment was performed in order to check previous observations that indicated an absorption anomaly in the cosmic ray component responsible for the production of low-energy nuclear reactions. A subtraction technique was used for the detection of slow neutrons, locally produced by cosmic radiation. Measurements performed at two different altitudes yielded practically the same absorption m.f.p. in air and in an equivalent dense absorber. This implies a small or even vanishing absorption anomaly. (auth)

10778 ENERGY BALANCE IN EXTENSIVE AIR SHOWERS. John R. Green (Univ. of New Mexico, Albuquerque). Am. J. Phys., 30: 108-15(Feb. 1962).

The production of an extensive air shower is discussed, starting with the elementary nuclear interaction and proceeding to the development of the shower components. Mention is made of experimental methods used to obtain information about the components, particularly with regard to the energy. Emphasis is placed on the division of the primary particle energy among the components. Numerical values are given to typify the magnitudes involved. (auth)

10779 DEPENDENCE OF SOLAR COSMIC-RAY INTENSITY ON LOCATION OF CHROMOSPHERIC FLARES. L. I. Dorman and E. V. Kolomeyets. Geomagnetizm i Aeronomiya, 1: 830-1(Sept.-Oct. 1961).

Soviet studies of cosmic neutron data indicate that conditions for the propagation of relatively high-energy particles (several Bev) toward the earth are independent of the longitudinal distribution of chromospheric flares. Thule monitored data confirmed that approximately twice as many low-energy particles were incident on the earth when a flare occurred on the western solar limb as when it occurred on the eastern limb. The analysis, covering 149 chromospheric flares with magnitudes of 2 or higher, shows that the intensity of solar cosmic rays produced by flares between the solar equator and 10° solar latitude is 1.5 times greater than the intensity of radiation from flares between 10 and 50° solar latitude. (OTS)

10780 MEASUREMENTS OF CORPUSCULAR RADIATION AT UP TO 100 km ELEVATION. L. A. Antonova (Inst. of Applied Geophysics, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 9, 1437-8 (Sept. 1961). (In Russian)

Corpuscular emission in the ionosphere was measured with an improved photomultiplier capable of measuring direct light intensity without side interference. A neutral light filter with a specially selected penetration coefficient was installed in front of the device. Reduced signals were received at increased elevation with a photomultiplier equipped with 0.18 mg/cm^2 aluminum and a ZnS(Ag) phosphor. With 2.0 mg/cm^2 of aluminum and a ZnS(Ag) phosphor, the device gave zero signals. The variations in photomultiplier signals are plotted as a function of corpuscular emission at various elevations from 75 to 100 km. (R.V.J.)

10781 THE ELECTRON DENSITY DISTRIBUTION ABOVE THE F2 PEAK AND ASSOCIATED ATMOSPHERIC PARAMETERS. S. J. Bauer (Goddard Space Flight Center, Greenbelt, Md.). J. Atmospheric Sci., 19: 17-19(Jan. 1962).

The distribution of free electrons in a heterogeneous upper ionosphere is discussed. According to theoretical arguments as well as experimental evidence, the electron density distribution well above the F2 peak corresponds to a diffusive equilibrium distribution. It is shown that accurate electron density measurements in this altitude region allow determination of associated atmospheric parameters such as scale height and temperature, as well as the nature and concentration of the light ions, since within this altitude region a transition occurs from the predominant heavy ion (O^+) to the light ions (H^+ and/or He^+). (auth)

10782 THE COSMIC-RAY FLARE EFFECT. 1. SOME NEW METHODS OF ANALYSIS. K. G. McCracken (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Research, 67: 423-34(Feb. 1962).

A systematic method for determining the angular dependence of the cosmic radiation in the vicinity of the earth during a cosmic-ray solar flare effect and a method for determing the rigidity spectrum of the radiation during the anisotropic phase of a flare effect are described. Calculations of the asymptotic directions of approach of particles using a simulation of the geomagnetic field which includes spherical surface harmonics up to the sixth degree, a method of correcting flare observations to a given atmospheric pressure level which takes into account the short attenuation length of the flare radiation, and a comparison which shows that a number of high-latitude sea-level neutron monitors are strictly comparable despite differences in their geometries are presented. (auth)

10783 THE COSMIC-RAY FLARE EFFECT. 2. THE FLARE EFFECTS OF MAY 4, NOVEMBER 12, AND NOVEMBER 15, 1960. K. G. McCracken (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Research, 67: 435-46(Feb. 1962).

Observations of the flare effects of May 4 and November 12 and 15, 1960, are analyzed. Attention is given to understanding the anisotropies that existed in the cosmic-ray fluxes during the events. For each event it is found that the flux was greatest from a direction to the west of the sun. During the May 4 event the flux was greatest from, and symmetrical about, a direction 55° to the west of the sun, and 10° north of the ecliptic, for more than 9 hours after the commencement of the flare effect. The differential rigidity spectrum is investigated, the power-law exponent being calculated to be −5.0 at 1045 UT, and shown to be decreasing (that is, the spectrum steepening) with time. For the November 12 event, it is shown that an anisotropy persisted until about 1900 UT, when the radiation rapidly became isotropic. At this same time, the counting rates of all neutron detectors increased very suddenly and a Forbush decrease was observed by meson detectors. It is shown that at about 1600 UT an additional anisotropic flux of radiation arrived at the earth from within the hemisphere centered upon the sun, and between 1700 and 1800 UT an additional anisotropic flux arrived from the opposite direction. For the November 15 event, it is shown that the radiation became isotropic within about 90 minutes of the commencement of the flare effect. The anisotropies at early times are studied, the most important observation being that particles were arriving from some directions in space for approximately 30 minutes before any arriving from the opposite direction. (auth)

10784 THE COSMIC-RAY FLARE EFFECT. 3. DEDUCTIONS REGARDING THE INTERPLANETARY MAGNETIC FIELD. K. G. McCracken (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Research, 67: 447-58 (Feb. 1962).

Observations of cosmic-ray flare effects made at sea level are used to investigate the magnetic fields within the inner solar system. Considering the temporal dependence of intensity, the degree of anisotropy, and the direction in space from which the fluxes were greatest it is concluded that, when a large, active sunspot group is on the far western portion of the solar disk, magnetic lines of force essentially connect the sunspot group to the earth. It is shown that small-scale irregularities exist in these lines of force. The over-all configuration of the magnetic field regime is investigated; the trapping of cosmic rays injected by solar flares and the exclusion of galactic cosmic rays are discussed. Relative merits of two contemporary theoretical models of the interplanetary fields established by solar activity are discussed. (auth)

10785 A MEASUREMENT OF SLOW COSMIC-RAY NEUTRONS UP TO 200 KILOMETERS. W. P. Reidy, R. C. Haymes, and S. A. Korff (New York Univ., University Heights). J. Geophys. Research, 67: 459-65(Feb. 1962).

An Aerobee-150A sounding rocket instrumented with 44 BF_3 proportional counters was launched from Wallops Island, Virginia, on August 23, 1960, a geomagnetically quiet day; the rocket reached about 200 km altitude. The counters were of two different boron isotopic enrichments, which permitted the determination of the counting rate due to neutrons, and an evaluation of the background due to highly ionizing events. These results are compared with previous measurements made with balloon-borne equipment above the equilibrium region and with the flux calculated for this region. (auth)

10786 THE INTERACTION OF THE TERRESTRIAL MAGNETIC FIELD WITH THE SOLAR CORPUSCULAR

RADIATION. 2. SECOND-ORDER APPROXIMATION. David B. Beard (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Research, 67: 477-83(Feb. 1962).

The previous calculation (D. B. Beard, J. Geophys. Research, 65: 3559(1960)), in which the shape of the interface between the solar plasma and the terrestrial magnetic field was computed neglecting the curvature of the interface, is improved. The magnetic field resulting from the current distribution on the first-approximation interface is included in the calculation, and the surface is recomputed in the plane containing the earth's dipole vector and the earth's orbital radius. As was anticipated in the first approximation, the daylit surface is altered very little but the nighttime surface and the polar regions are significantly changed. At the magnetic equator the height of the surface is very slightly reduced, but the height of the surface increases over the polar regions. The null point, where the surface current and magnetic field component tangential to the surface drop to zero, occurs on the dark side of the earth. (auth)

10787 HYDROMAGNETIC WAVES AND THE TRAPPED RADIATION. PART 3. EFFECTS ON PROTONS ABOVE THE PROTON BELT. Donat G. Wentzel (Univ. of Michigan Observatory, Ann Arbor). J. Geophys. Research, 67: 485-98(Feb. 1962).

It was previously shown that hydromagnetic waves in the magnetosphere cause a systematic drift of the mirror points of energetic protons (D. G. Wentzel, J. Geophys. Research, 66: 359, 363(1961)). Above the proton belt these waves do not travel parallel to the dipole field. Systematic changes of the magnetic moment due to such waves are computed numerically for particle orbits and waves. Results are qualitatively similar to those for transverse waves unless the Larmor gyration carries the particle across a major part of a wave, in which case systematic changes are small. The hm waves above the proton belt are estimated to be nearly sinusoidal and are estimated to travel at a typical angle of 45° relative to the dipole field. Such waves systematically raise the mirror points of proton orbits above the proton belt, especially if the mirror points are near the atmosphere. Numerical estimates indicate that this process is about as efficient as the lowering of the mirror points by random walk, but the uncertain nature of the hm waves permits only the conclusion that the time needed to remove a proton into the atmosphere is longer than that estimated from random walk alone. The only mirror points that appear to be systematically lowered are near the upper boundary of the proton belt, which is determined jointly by systematic and random-walk effects. (auth)

10788 A NOTE ON THE VERTICAL CUTOFF RIGIDITIES OF COSMIC RAYS IN THE GEOMAGNETIC FIELD. A. Freon (CNRS, Paris and Ecole Normale Supérieure, Paris) and K. G. McCracken. J. Geophys. Research, 67: 888-90(Feb. 1962).

Temporal variations in counting rates were observed at Port aux Francais, Kerguelen Island, during the flare effects of Nov. 12 and 15, 1960, using a neutron monitor. The dependence of counting-rate enhancement upon vertical cutoff rigidity was plotted and compared with calculations of J. J. Quenby and W. R. Webber (Phil. Mag., 4: 90(1959)). The extrapolations from measurements at the earth's surface are adequate to explain the observed effects, and the Quenby-Webber approximations are not valid at this station, due to the Cape Town magnetic anomaly. (L.N.N.)

10789 UNDERWATER COSMIC RAY MEASUREMENT. Gordon K. Riel and Donald G. Simons (U. S. Naval Ordnance Lab., Silver Spring, Md.). J. Geophys. Research, 67: 891 (Feb. 1962).

A single detector with energy discrimination is used to distinguish between cosmic-ray and radioactive-nuclide events. The maximum energy resulting from any naturally radioactive source is 7.2 Mev; a single detector with an energy threshold above 7.2 Mev can be used as a cosmic ray counter. Data on the high-energy count rate versus the depth are presented in graphical form. No restrictions on angular distributions of radiation detected were placed. (L.N.N.)

10790 A STUDY ON NUCLEAR-ACTIVE COMPONENT IN EXTENSIVE AIR SHOWERS AT MOUNTAIN ALTITUDE. Kensaku Hinotani (Osaka City Univ.). J. Phys. Soc. Japan, 17: 24-35(Jan. 1962). (In English)

The nuclear-active component (N-component) in extensive air showers was observed using a large multiplate cloud chamber and two standard neutron monitors installed in EAS array consisting of 16 density detectors. High-energy N-particles above 10 Bev were observed by the multiplate cloud chamber, while N-particles of above 200 Mev were observed by the neutron monitor separately. The integral energy spectra of N-particles are shown to be represented by $E^{-0.7\pm0.1}$, $E^{-1.1\pm0.2}$ and $E^{-1.5\pm0.2}$ for the events observed at distances 0 to 5, 5 to 10 and more than 10 m, respectively, from shower axis. The integral energy spectrum of total N-particles is expressed by $E^{-1.0\pm0.1}$. The lateral distribution of N-particles above 10 Bev is $r^{-1.4\pm0.2}$ within 25 m of the axis. The lateral distribution of low-energy N-particles is expressed by $r^{-1.0\pm0.2}$ for distances of 5 to 30 m, and the distribution becomes flatter within 5 m. These lateral distributions of each energy region can be well fitted by an exponential function, $\exp(-r/r_0)$, rather than the above power function. The characteristic lengths, r_0, are obtained as 20, 7 and 1.2 m for energies $\geq 2 \times 10^9$ ev, $\geq 10^{10}$ ev and $\geq 10^{11}$ ev, respectively. The lateral structure of energy flow carried by low-energy N-particles is represented by $r^{-1.8\pm0.2}$ and larger air showers have slightly steeper structures of energy flow. The total number of N-particles at above 200 Mev, N_N, varies with the size of EAS, N_e, as follows;

$$N_N \propto N_e^{1.0\pm0.1} \quad (10^5 < N_e \leq 3 \times 10^6)$$
$$N_N \propto N_e^{0.6\pm0.1} \quad (N_e > 3 \times 10^6)$$

This experiment was performed at 2770 m above sea level. (auth)

10791 ENERGETIC ELECTROMAGNETIC CASCADE PRODUCED IN A HIGH ENERGY NUCLEON-NUCLEON INTERACTION. P. L. Jain (Univ. of Buffalo). Nuovo cimento (10), 22: 1104-10(Dec. 1, 1961). (In English)

In a stack of Ilford G-5 emulsion consisting of 200 pellicles exposed to cosmic radiation at 116,000 ft altitude, events of the type 4 + 27 p were observed. Angular and energy distributions were measured. Primary particles producing the events are likely to be mesons(π^+) rather than protons. No charged mesons above 120 Bev were found in the primary interactions. (L.N.N.)

10792 ABSORPTION MEAN FREE PATH OF THE NUCLEONIC COMPONENT OF COSMIC RADIATION. A. Cicchini and J. Chagalj (Universidad, Buenos Aires). Phys. Rev. 124: 1201-3(Nov. 15, 1961).

The absorption mean free path L of star-producing radiation was determined using the local production of neutrons in condensed materials; a neutron monitor was installed in an aircraft, and two flights were performed at the geomagnetic latitudes 23.3°S (Buenos Aires) and 15°S (Asuncion). The results show an increase in L of

about 20% for an altitude increase of 6000 m in Buenos Aires, and of 40% in Asuncion, for the same altitude increase; the total L value in Asuncion was found to be 175 g cm^{-2}, while in Buenos Aires it was 163 g cm^{-2}. (auth)

10793 LONGITUDINAL DISTRIBUTION OF ČERENKOV LIGHT FROM EXTENSIVE AIR SHOWERS. Forrest I. Boley, James H. Baum, John A. Palsedge, and Joseph H. Pereue (Wesleyan Univ., Middletown, Conn.). Phys. Rev. 124: 1205-8(Nov. 15, 1961).

Measurements of the longitudinal distribution of the Cherenkov light associated with extensive cosmic showers of approximately 10^{15}-ev minimum energy are presented. These measurements are compared with those of Bassi et al. resulting from analysis of the electron component of extensive air showers and with the distribution calculated by Monte Carlo techniques from Coulomb scattering of the shower electrons. (auth)

10794 SEARCH FOR PRIMARY COSMIC GAMMA RAYS WITH THE SATELLITE EXPLORER XI. W. L. Kraushaar and G. W. Clark (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 8: 106-9(Feb. 1, 1962).

A search was made for gamma radiation produced in cosmic radiation interactions with interstellar matter. Incident gamma radiation above about 50 Mev was converted into electron-positron pairs in a sandwich scintillator (alternate slabs of CsI and NaI) about one radiation length in thickness. Upper-limit and arrival-direction data are presented in graphical and tabular forms, respectively. It is suggested that the likely source of high-energy cosmic γ rays is π^0-producing interactions between ordinary charged cosmic rays and gas. (L.N.N.)

10795 PROBLEMS OF COSMIC RAY SOURCES IN ASTRONOMICAL SITUATIONS. Martin Johnson. Quart. J. Roy. Astron. Soc., 2: 236-53(Dec. 1961).

Although there are notable correlations of cosmic ray increase with a solar flare and decrease with a geomagnetic storm, both suggestive of solar radio emissions, 10^{17} sun-like stars would be required, instead of the 10^{11} stars of the Galaxy, to supply the estimated galactic concentration of cosmic rays. Interstellar and more active stellar situations are examined for the magnetic acceleration of ions. A distinction is drawn between direct stellar accelerators to the observed spectral distribution of cosmic rays, and injectors supplying suprathermal ions to interstellar space for subsequent re-acceleration. Evidence for the status of the galactic halo and of supernova accelerators is therefore examined, also a study of binary stars as injectors. (auth)

10796 ENCYCLOPEDIA OF PHYSICS. S. Fluegge, ed. Volume XLVI/1. Cosmic Rays I. Berlin, Springer-Verlag, 1961. 338p.

Origin and geomagnetic effects of cosmic radiation are discussed. Results of stratospheric measurements are given. Penetrating and extensive showers are explained, and the hard component of mesons (μ) in the atmosphere is discussed. The volume is divided into 6 sections, separate abstracts have been prepared for each. (L.N.N.)

10797 THE ORIGIN OF COSMIC RAYS. P. Morrison. p.1-87 of "Encyclopedia of Physics." Berlin, Springer-Verlag. 1961. (In English)

Cosmic-ray properties are summarized, and a physical model of the origin is presented. Cosmic-ray propagation in space is described in terms of particle interactions with media, photons, and magnetic fields. Acceleration by magnetic fields, hydromagnetic wave properties, and radiation by charged particles in magnetic fields are discussed. Particle diffusion is described, and the astronomical setting is discussed. (L.N.N.)

10798 THEORY OF THE GEOMAGNETIC EFFECTS OF COSMIC RADIATION. Manuel Sandoval Vallarta. p.88-129 of "Encyclopedia of Physics." Berlin, Springer-Verlag, 1961. (In English)

The theory of charged particle motion in the Earth's magnetic field is summarized. Directions from which particles at given energies may or may not arrive at given points are discussed, considering that the Earth itself is an impenetrable body. Properties of the allowed cone, consisting of the main cone, penumbra, and shadow cone, and of the Stoermer cone are given. (L.N.N.)

10799 EXPERIMENTAL RESULTS OF FLIGHTS IN THE STRATOSPHERE. Ernest C. Ray. p.130-56 of "Encyclopedia of Physics." Berlin, Springer-Verlag, 1961. (In English)

Interactions of the primary cosmic radiation beam with atoms and nuclei in the atmosphere and secondary radiations emitted are discussed. Effects due to the influence of the Earth's magnetic field on the primary radiation are explained. Intensities and measurements are discussed, and data are presented. (L.N.N.)

10800 PENETRATING SHOWERS. Kurt Sitte. p.157-214 of "Encyclopedia of Physics." Berlin, Springer-Verlag, 1961. (In English)

Penetrating showers are the result of high-energy interactions of nucleons with nucleons or nuclei. Fast secondaries are emitted, most of which are mesons(π), and contribute to the nucleonic shower propagation. Shower symmetry and degrees of inelasticity are discussed, and total cross sections are measured. In light elements, the primary has a not-negligible possibility of traversing a nucleus without colliding with a target nucleon. At high primary energies, the collision should be pictured as a composite reaction of an incident particle colliding with a whole group of nucleons in the target nucleus. (L.N.N.)

10801 EXTENSIVE AIR SHOWERS. Giuseppe Cocconi. p.215-71 of "Encyclopedia of Physics." Berlin, Springer-Verlag, 1961. (In English)

Extensive air showers are described. The electromagnetic cascade is discussed in terms of the theory of longitudinal development and lateral and time distributions. Experimental results are explained in terms of the density spectrum, development in the atmosphere, localization of the shower core, lateral distribution, and the number spectrum. The meson-nucleon cascade is discussed in terms of data from the N component and the μ component above ground and underground. The nature and energy spectrum of primary radiation and the time variations correlated with atmospheric and primary-radiation changes are explained. (L.N.N.)

10802 THE HARD COMPONENT OF μ-MESONS IN THE ATMOSPHERE. G. N. Fowler and A. W. Wolfendale. p.272-315 of "Encyclopedia of Physics." Berlin, Springer-Verlag, 1961. (In English)

Measurements on meson (μ) development through the atmosphere were made and applied to investigations of nucleon-nuclei interactions and magnetic field effects on primary and secondary cosmic radiation. Techniques include the magnetic-deflection and scattering methods. Properties of the meson(μ) component in the vertical and in inclined directions are discussed, and comparisons with meson(π) production models are made. Meteorological effects are discussed. (L.N.N.)

10803 RESEARCHES OF THE DEPARTMENT OF TERRESTRIAL MAGNETISM. VOLUME XXI. COSMIC-RAY RESULTS AND SUMMARIES TO 1959. Liselotte Beach and S. E. Forbush (Carnegie Institution of Washington, D. C.). Publication 175. 1961. 229p.

Tables of measured cosmic radiation values are presented. Diurnal and bihourly and daily mean variation in units of 0.01 and 0.1%, are presented. Methods for data reduction are discussed. (L.N.N.)

Criticality Studies

10804 (ANL-6487) THE THEORY AND MEASUREMENT OF CRITICALITY. Charles N. Kelber (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-Eng-38. 24p.

The measurable properties of a critical assembly (e.g., fission, capture, and leakage rates; neutron-per-fission ratios; bare/Cd-covered reaction rate ratios; danger coefficients; etc.), whose judicious use completely defines the neutron economy in the assembly, are discussed. Requirements regarding the internal consistency of these measured quantities are reviewed. It is concluded that theoretical analysis of the assembly must both reproduce the gross experimental results and reflect the internal consistency of the data. Only thermal systems fueled with U^{235} and U^{238} are considered. (T.F.H.)

10805 (DC 59-11-73) CRITICALITY HAZARDS STUDY ON REACTIVE MIXTURES OF BeO, H_2O AND ORALLOY. D. E. Wetzel (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 10, 1959. Contract AT(11-1)-171. 14p.

Critical mass and radius data are presented for reactive mixtures containing beryllium oxide, water, and Oralloy (93.2% U^{235} by weight) reflected with an approximately infinite thickness of water. These data were generated by a multiregion, nineteen energy level plus thermal, diffusion theory reactor program. Results show that the minimum critical mass occurs at a relative concentration of 250 molecules of water to one atom of U^{235}. Critical mass and radius at this point are 0.96 kg of U^{235} and 16.4 cm, respectively. Additions of beryllium oxide (54 and 81 molecules per U^{235} atom) had little effect on critical mass, particularly at high water concentrations. These results are to be used in support of study of safety practices employed in ceramic type fuel element fabrication and storage. (auth)

10806 (DC-59-11-158) ANALYSIS OF LIVERMORE GRAPHITE MODERATED CRITICAL EXPERIMENT AND COMPARISON WITH EXPERIMENTAL DATA. E. R. White (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 20, 1959. Contract AT(11-1)-171. 7p.

Results of nuclear analysis on a graphite moderated, critical experiment are presented. It was found that critical masses in this system could be calculated at elevated temperatures with significant correlation with experimental data. (auth)

10807 (HW-66882) K_∞ OF THREE WEIGHT PER CENT U^{235} ENRICHED UO_3 AND $UO_2(NO_3)_2$ HYDROGENOUS SYSTEMS. V. I. Neeley, J. A. Berberet, and R. H. Masterson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1961. Contract AT(45-1)-1350. 52p.

The value of the infinite multiplication constant (k_∞) was determined as a function of the hydrogen-to-uranium (H:U) atomic ratio for 3.04 weight per cent U^{235} enriched UO_3 and $UO_2(NO_3)_2$ hydrogen moderated homogeneous systems. The work was done to evaluate nuclear safety of and establish operational limits for slightly enriched homogeneous systems and was performed in the Hanford Physical Constants Testing Reactor. The amount of thermal neutron absorber, commonly referred to as poison, necessary to reduce the value of k_∞ of these systems to unity was also obtained directly from these studies. This value is of interest for processing reactor fuels in which soluble poisons would be used for criticality control. Curves of the value of k_∞ as a function of the H:U atomic ratio for 3.04 weight per cent U^{235} enriched UO_3 and $UO_2(NO_3)_2$ are shown. The curve of k_∞ versus H:U was determined by a least squares fit to the experimental data. Values of the amount of thermal poison necessary to reduce k_∞ to unity as a function of the H:U ratio are tabulated. (auth)

10808 (HW-69808) THE MULTI-DECADE SIMULATION OF THE PLUTONIUM RECYCLE PROGRAM CRITICAL FACILITY. G. R. Taylor (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1961. Contract AT(45-1)-1350. 41p.

The simulation of the Plutonium Recycle Program (PRP) Critical Facility (Experimental Reactor) is described in some detail. The simulation must be capable of handling large nuclear power excursions for the purpose of hazards analysis. Special emphasis is placed on the use of point storage (or analog memory) techniques in the multi-decade operation of the reactor simulator. A method is also described of producing the point storage function in a general-purpose analog computer. (auth)

10809 (RFP-108) METHOD FOR CALCULATING U^{235} METAL STORAGE ARRAYS. C. L. Schuske (Dow Chemical Co. Rocky Flats Plant, Denver). May 7, 1958. Contract AT(29-1)-1106. 13p.

A method is presented which can be used to calculate the critical masses of U^{235} metal storage configurations. The method employs several graphs and empirical equations. In addition three constants need to be known for any given representative mass unit in the array: self multiplication M_s, lattice density, and the equivalent mass. The figures contained in the report were derived using a limited amount of data. (auth)

Elementary Particles and Radiations

10810 (AFCRL-636) ON THE MOTION OF A CHARGED PARTICLE IN A TIME-DEPENDENT MAGNETIC FIELD. Scientific Report No. 6. E. T. Y. Lee and W. H. Reid (Brown Univ., Providence). June 1961. Contract AF19(604)-7236. 19p. (AD-259175)

The motion of charged particles in homogeneous magnetic fields which vary linearly with time is investigated. An exact expression for the variation of the magnetic moment is obtained and is compared with the approximate results of Hertweck and Schluter. It is found that both analyses give the same asymptotic behavior of the moment for slow changes of the field, at least up to the second-order in the rate of change of the field. (auth)

10811 (AFOSR-1890) MODIFIED LEE MODELS AND THE FIELD THEORETICAL DEFINITION OF ELEMENTARY PARTICLE. Francesco Calogero (California. Univ., Berkeley). Oct. 1961. Contract AF 49(638)-327. 107p.

Exactly solvable models of field theories are introduced and discussed. In some of these models the physical states

involve an infinite number of bare particles. Some solutions are also found, which depend in a nonanalytic way on the coupling constant: these solutions may appear as new elementary particles. The field theoretical definition of elementary particle is then discussed. The renormalized coupling constants are always assumed to be smaller than some critical values (depending on the form factors of the models), thereby excluding any pathological features (such as ghost states). (auth)

10812 (CERN-61-30) PARTICLE PHYSICS, CERN SEMINARS 1961. M. Baldo-Ceolin, G. Feinberg, T. D. Lee, A. Pais, and G. A. Snow (European Organization for Nuclear Research, Geneva). Dec. 1, 1961. 142p.

Ten lectures are included which treat various topics in particle physics. The topics include N-$\bar{N}$ annihilation, the $\Delta Q = \Delta S$ selection rule, leptonic decay of strange particles, high-energy neutrino experiments, the two-neutrino hypothesis, and the relative Σ-Λ parity. (D.L.C.)

10813 (CERN-62-2) THE IDENTIFICATION OF HIGH ENERGY Λ^0s, $\bar{\Lambda}^0$s, AND K_1^0s IN BUBBLE CHAMBER EXPERIMENTS. R. A. Salmeron and R. G. P. Voss (European Organization for Nuclear Research, Geneva). Jan. 4, 1962. 22p.

An estimate of the probability of identifying Λ^0, $\bar{\Lambda}^0$, or K_1^0 in bubble chamber experiments as a function of the momentum of the decaying particle, in the momentum range from 1 to 25 Gev/c, is given. Two general cases were considered. Three methods of analysis of neutral V-events were used: the calculation of the Q-value, the use of the α-p_t diagram, and the use of the α-ϵ diagram where α and ϵ are the parameters of Podolanski and Armenteros. Computer programs were used to calculate the kinematics and the associated errors. It was assumed that the particles decay isotropically in their rest frame. (M.C.G.)

10814 (JINR-D-793) FENOMENOLOGICHESKOE RASSMOTRENIE PROTSESSOV OBRAZOVANIYA π-MEZONOV π-MEZONAMI. (Phenomenological Treatment of the Formation Processes of π-Mesons by π-Mesons). K. S. Marish (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 32p.

Production of π mesons in π interactions with protons at 1.5 Bev was analyzed. Two π interactions with isotopic spin $T_{\pi\pi} = 0$ and $T_{\pi\pi} = 2$ (with $T_{\pi\pi} = 0$ more probable) are prevalent with a center of mass at 400 Mev. At larger energies the contribution of each meson changes. Two cross section maximums in charged particle production by π mesons at 600 to 800 Mev are explained using a 2-π interaction model with isotopic spin $T_{\pi\pi} = 1$. The third maximum at 1370 Mev is explained by π mesons with $T_{\pi\pi} = 2$. (tr-auth)

10815 (JINR-P-831) DINAMICHESKAYA POLYARIZATSIYA PROTONOV V PEREKISYAKH VODORODA I TRETICHNOGO BUTILA. (Dynamic Polarization of Protons in Hydrogen Peroxides and Tertiary Butyl). V. I. Lushchikov, A. A. Manenkov, and Yu. V. Taran (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics and Akademiya Nauk S.S.S.R. Institut Fiziki im. P. N. Lebedeva). 1961. 7p.

The dynamic polarization of protons in H_2O_2 and $[(CH_3)_3CO]_2$ was investigated. The signal of the proton magnetic resonance for H_2O_2 is increased as much as 3.5 times in saturating the electronic paramagnetic resonance of free radicals at 1.6°K. For $[(CH_3)_3CO]_2$, the proton polarization is 12 times greater at 42°K and 8 times at 1.6°K. The lifetimes of the spin-lattice nuclear relaxation were obtained. (auth)

10816 (NP-11300) DANNYE O π-π VZAIMODEISTVII IZ REAKTSII ROZHDENIYA π MEZONOV V π-p SOUDARENIYAKH. (Data on the π-π Interaction in the Formation of π-mesons in π-p Collisions). Ya. Ya. Shalamov and A. F. Grashin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1961. 21p. (ITEP-31-61)

Processes of multiple π-meson production by π-p collisions at 2.8 Bev are studied by means of a bubble chamber filled with a xenon-propane mixture. A strong interaction between π mesons was observed in the final stages of $\pi^- + p \rightarrow \pi^- + \pi^0 + p$. Resonance type interactions were not found in reactions of three π mesons with isotopic spin I = 1. The energy and angular distribution peculiarities of secondary particles are explained by considerable pole diagram contributions. The cross section of π-π^0 scattering is 90 mb at $\omega^2 \simeq 25\mu^2$; the cross section decreases rapidly with increased π meson energy. (R.V.J.)

10817 (NP-11301) DAL'NEISHIE POISKI $\mu \rightarrow e + \gamma$ RASPADA. (Further Search for the Decay $\mu \rightarrow e + \gamma$). A. N. Alikhanov, A. I. Babaev, M. Ya. Balats, V. S. Kaftanov, L. G. Landsberg, V. A. Lyubimov, and Yu. V. Obukhov (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1961. 7p. (ITEP-30-61)

A search for $\mu \rightarrow e + \gamma$ decay was made by correlating spark chambers with fast electronics. The scheme of the installation is given. A beam of 70 Mev π^+ mesons produced by a 680-Mev proton synchrotron was separated by monitor coincidences 1, 2, and 0. The beam intensity corresponded to 2300 π^+ stops per second. The coincidence count 0A (4, 5, 6 + 7, 8, 9 + 1, 2, 3 + 10, 11, 12) corresponded to the number of $\mu \rightarrow e + \nu + \bar{\nu}$ decays. The measurements show the upper boundary of $\mu \rightarrow e + \gamma$ decay is $\rho_{exp} < 1.5 \times 10^{-7}$ (with 50% accuracy) and $\rho_{exp} < 5 \times 10^{-7}$ (with 90% accuracy). (R.V.J.)

10818 (NP-11390) BEUGUNGSTHEORIE UND N-KÖRPERPROBLEM. (Diffraction Theory and the n-Body Problem). Guido Beck (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1961. 25p. (Notas de Fisica Vol. VIII, No. 13, p.211-34).

A method developed for the treatment of diffraction problems is used for a several-body problem with reciprocal action force of limited range, and a formalism is presented for the direct generalization of the case of one particle in an external potential field. The bent waves correspond to the total of the allowed energies of elastic and inelastic processes. A configuration is shown in which decaying waves of a particle correspond to excited states of a system at rest and which is determinative for the structure of the system surface. An analog is indicated between the surface structure of a n-body problem and the external structure of a quantum theoretical eigenfield. (D.L.C.)

10819 (AERE-Trans-880) A SOURCE OF POLARIZED DEUTERONS AND DETECTION OF THE POLARIZATION BY THE (d,T) REACTION. H. Rudin, H. R. Striebel, E. Baumgartner, L. Brown, and P. Huber. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Helv. Phys. Acta, 34: 58-84(1961). 34p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 16426.

10820 (UCRL-Trans-784) THE MAGNETIC MOMENT OF THE PROTON. B. G. Lazarev and L. W. Shubnikov. Translated for Univ. of California Lawrence Radiation Lab., Berkeley from Physik. Z. Sowjetunion, 11: 445-57(1937). 26p.

The magnetic susceptibility of solid hydrogen at 4.22, 2.18, and 1.76°K was measured. It was found that in this temperature range the diamagnetic susceptibility decreases.

The decrease is attributed to the increase in paramagnetism caused by the magnetic moment of the proton. The magnetic moment of the proton (m_p) was found to be 2.3 ± (0.2 to 0.3) from three measurements groups and the more exact value of 2.7 from the measurement at 1.76 and 2.18. (J.R.D.)

10821 STUDIES OF SPIN DEPENDENCE IN ELASTIC NUCLEON-NUCLEON INTERACTIONS. II. POLARIZATION PHENOMENONA IN NUCLEON-NUCLEON ELASTIC INTERACTIONS. Emil Iliescu. Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 707-25(1961). (In Rumanian)

Measurements were made of the polarization in elastic nucleon-nucleon interactions, and formulas are derived for the scattering density matrix. (R.V.J.)

10822 THE PRESENT STATE OF THE NON-LINEAR SPINOR THEORY OF ELEMENTARY PARTICLES. W. Heisenberg (Max-Planck-Institut für Physik und Astrophysik, Munich). Acta Phys. Austriaca, 14: 328-39(1961). (In German)

The basic experimental data on which the non-linear theory of elementary particles is based are reviewed, and the basic conceptions drawn from this data are discussed. The problems which arise from the theoretical expansion of these data are described, and progress made in the resolution of these problems is reviewed. (J.S.R.)

10823 CHEW-LOW FORMALISM FOR TWO NUCLEON-MESON SYSTEMS. William M. Frank (U. S. Naval Ordnance Lab., Silver Spring, Md.). Ann. Phys. (N. Y.), 17: 205-39(Feb. 1962).

The system of two nonrelativistic nucleons interacting with symmetric pseudoscalar mesons is considered via an expansion in terms of the meson cloud of fixed nucleons. A Chew-Low formalism is constructed for the fixed two-nucleon system. Matrix elements of meson field operators between physical states can be expressed in terms of matrix elements of spin-isospin operators and propagators. It is demonstrated that for a class of nonsingular propagators the latter as a function of separation of the fixed nucleons can be expanded in a convergent expansion about infinite separation. The energies of the bound meson states are the static nuclear potentials, and an integral equation for them is derived. (auth)

10824 FIELD OF A PARTICLE IN UNIFORM MOTION AND UNIFORM ACCELERATION. Nathan Rosen (Israel Inst. of Tech., Haifa). Ann. Phys. (N. Y.), 17: 269-75 (Feb. 1962).

The line element in the neighborhood of a charged particle, according to general relativity theory, is put into the isotropic form. Using a Lorentz transformation the gravitational and electromagnetic fields of a particle in uniform motion are obtained. By transforming to a uniformly accelerated system, the fields of a particle accelerated in a uniform gravitational field are obtained. From the form of the solution it can be concluded that a charged particle in a uniform gravitational field does not radiate. (auth)

10825 THE NONMESON DECAY OF A HYPERFRAGMENT Λ He^5. Carlo Depietri (Università, Modena, Italy). Atti seminar. mat. e fis. univ. Modena, 10: 192-6(1960-61). (In Italian)

A charged particle, emitted from a cosmic star of the type 21 + 7p in nuclear emulsions, decays into two singly charged particles after a path of 117 μ. The event was interpretated as the nonmeson decay of hyper He^5 into a proton, a triton, and a neutron. The bonding energy of Λ° and the resulting decay scheme are in agreement with the very few known examples of the nonmeson decay of this hyperfragment. The bonding energy coincides with that deduced for the hyperfragment stars from more numerous cases of meson decay. (tr-auth)

10826 ON THE MAJORIZATION PROBLEM IN PERTURBATION THEORY. W. Garczyński (Univ. of Wrocław, Poland). Bull. acad. polon. sci., Ser. sci., math., astron. et phys., 9: 819-25(1961). (In English)

Feynman diagram majorization using a general parametric representation for the scattering amplitude in perturbation theory is discussed. The general case of the diagram with an arbitrary structure of vertices is considered, and a criterion of majorization is obtained (K. Symanzik, Prog. Theor. Phys., 20: 690(1958)). (L.N.N.)

10827 THE TRANSVERSE STERN-GERLACH EXPERIMENT. Myer Bloom and Karl Erdman (Univ. of British Columbia, Vancouver). Can. J. Phys., 40: 179-93(Feb. 1962).

It is shown theoretically that if a beam of neutral spin $\frac{1}{2}$ particles incident along the z axis is passed through an inhomogeneous, time-dependent magnetic field of the form $H(r,t) = H_0k + [h_1(x,y)i + h_2(x,y)j] \cos \omega t$, with $|H_0| \gg |h_1|$, $|h_2|$, the beam is split into two beams in the x – y plane when the resonance condition, $\omega = \gamma H_0$, is satisfied. The properties of the beams are similar to those obtained in the ordinary Stern-Gerlach experiment. They represent spins in the two eigenstates of S_x in a co-ordinate system rotating at the Larmor frequency about the z axis. For particles of angular momentum $J > \frac{1}{2}$, the beam would be split into 2J + 1 beams. For atoms with unequally spaced energy levels E_i and eigenfunctions ψ_i in the field H_0k, two beams are split off from the main beam when the resonance condition $h\omega = E_i - E_j$ is satisfied. For an initially unpolarized beam, these two beams have eigenfunctions $(1/\sqrt{2})(\psi_i \pm \psi_j)$. Magnetic resonance measurements similar to those made using the Rabi modification of the Stern-Gerlach experiment may be performed with the transverse Stern-Gerlach experiment. For charged particles of spin $\frac{1}{2}$ the resonance frequency is $\gamma H_0 - \omega_c$ where ω_c is the cyclotron frequency. The transverse Stern-Gerlach experiment may be used to measure the magnetic moments of charged particles and an experiment on free electrons is being carried out. Magnetic resonance spectroscopy of ions may be studied using this technique. Another application is in the production of beams of polarized nuclei. Since this may be done with nuclei in ions, it may be possible to produce polarized beams of high intensity in a form useful to nuclear physics experiments. (auth)

10828 TWO-PION RESONANT STATE AT 575 Mev. Roland Barloutaud, Jacques Heughebaert, Antione Lévêque, Joao Meyer, and Roland Omnès (Centre d'Etudes Nucleaires, Saclay, France). Compt. rend., 254: 252-4(Jan. 8, 1962). (In French)

Evidence is found for the existence of a dipion (mass 575 ± 20 Mev, isobaric spin 1) by studying the inelastic π^+-p interaction at π^+ energies of 820, 900, and 1050 Mev. (tr-auth)

10829 THE SPIN OPERATOR $\vec{S}^2$ AND THE SPIN WAVE FUNCTIONS OF THE SPIN $\frac{1}{2}$ PARTICLES. Yu-Tung Yang (National Tsin-Hua Univ., Taipei, [China]). Ho Tsu K'o Hsueh, 3: No. 2, 1-6 (1961). (In Chinese)

Mathematical deductions are provided for the relation of the spin operator $\vec{S}^2$ with the eigenvalues of the spin wave function ψ_s in the spin equation $\vec{S}^2\psi_s = N\hbar^2\psi_s$. It is demonstrated that if ψ_s is symmetric, the formula

$$\vec{S}^2 = \left\{\frac{3n + 2\,[1 + 2 + \ldots + (n + 1)]}{4}\right\}\hbar^2,$$

applies, and if the ψ_s is two factor and antisymmetric, the formula

$$\bar{S}^2 = \left\{\frac{3n + 2\,[0 + 1 + 2 + \ldots + (n + 3)]}{4}\right\}\hbar^2,$$

applies. $\hbar$ is the Plank's constant divided by 2π and n is the number of points in a group. (TTT)

10830 ANGULAR DISTRIBUTION AND POLARIZATION OF INTERFERING RADIATION. E. V. Sekhposyan and M. L. Ter-Mikaelyan. Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 14: 143-54(1961). (In Russian)

In processes involving bremsstrahlung and the creation of pairs at high energies large separation distances exist and these increase with the energy of the primary particle. When crystalline targets are used the distances can be as large as the elementary crystal lattice. For such cases it is necessary to account for the interference events that occur with the periodic structure of the crystal. The present investigation examines the angular distribution of the quanta and electron-positron pairs created in a crystal by an incoming electron as well as the polarization of the created bremsstrahlung. Use is made of the method of coupling parameters (Weizsacker–Williams method). The calculation involving bremsstrahlung created by an electron in the crystalline field is carried out in a coordinate system in which the electron is stationary. The pseudophotons of the oncoming crystal will then disperse against the electron and the dispersion of the quanta after transformation into laboratory coordinates gives the bremsstrahlung distribution. The polarization obtained in the crystal is the same as that obtained for a single atom when using the identical method of calculation. (TTT)

10831 RADIATION DIFFUSION IN ANISOTROPIC MEDIUM ADJOINING A REFLECTING SURFACE. S. D. Gutshabash (Frunze Navy School, [USSR]). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 1, 118-25(Jan. 1962). (In Russian)

A method of probabilities is used in investigating radiation diffusion in an anisotropic scattering atmosphere of finite optical thickness adjoining a reflecting surface. The equations derived for the quantum yield from the medium are used for finding the intensity of the emitted radiation from an arbitrary distribution of emitting sources. Cases in which the medium is illuminated by parallel rays and in which the source is inside the medium are analyzed. (R.V.J.)

10832 ONE-PION EXCHANGE AND THE OPTICAL MODEL. Frank E. Bjorklund, Bernard A. Lippmann, and Michael J. Moravcsik (Univ. of California, Livermore). Nuclear Phys., 29: 582-603(Feb. 1962). (In English)

Starting with the two-body scattering amplitude, an optical model potential for nucleon-nucleus scattering is calculated (1) using the one-pion exchange interaction alone, (2) modifying the s-wave part of this by using effective range theory, and (3) using the modified phase shift analysis for p-p scattering supplemented by charge independence and the Gammel-Thaler potential for the n-p scattering information. Part (1) works sufficiently well to suggest that the one-pion exchange force contributes more importantly to the nucleon-nucleus interaction than to the basic two-nucleon scattering process. Part (2) produces an indifferent improvement on part (1). Part (3) represents the optical potential inferred from the most accurate two-nucleon data presently available. This last evaluation of the optical potential is considered the most reliable to date since it includes, in a good approximation, an infinite number of the high angular momentum states of the two-nucleon amplitude, which play a very essential part in the optical potential. A systematic derivation of the optical model equations is included with special emphasis on the needs of the present calculation; in addition, criteria for the validity of the model are discussed. Allowance is made for the nuclear volume not being strictly proportional to the mass number (nuclear size effect) and for the inequality of the numbers of neutrons and protons in the nucleus (effect of neutron excess). For heavy nuclei, these effects influence results up to 25%. (auth)

10833 LOW ENERGY K^--p SCATTERING AND $\bar{K}N$ BOUND STATES. M. M. Islam (Imperial Coll. of Science and Tech., London). Nuclear Phys., 29: 635-47(Feb. 1962). (In English)

Assuming that the recently discovered Y^* ($m_{Y^*} \approx 1385$ Mev, $\frac{1}{2}\Gamma \approx 15$ Mev) is a $\bar{K}N$ (I = 1) bound system, an effective range theory for $\bar{K}N$ scattering in the I = 1 state is formulated. With a large effective range for the I = 1 state and a zero effective range for the I = 0 state, parameters which fit the present low energy K^--p scattering data and give constructive Coulomb-nuclear interference are found. The parameters indicate that the real part of the scattering length in the I = 0 state (i.e. a_0) is small. This smallness of a_0 is explained by postulating the existence of a $\bar{K}N$ (I = 0) bound state lying below the $\Sigma\pi$ threshold. A $\Sigma\pi$ resonance (I = 0) is expected just below the $\bar{K}N$ threshold ($\delta_{\Sigma\pi} = 90°$). (auth)

10834 ON THE SCATTERING OF PIONS BY DEUTERONS. Alladi Ramakrishnan, V. Devanathan, and K. Venkatesan (Univ. of Madras). Nuclear Phys., 29: 680-6(Feb. 1962). (In English)

The pion scattering by deuterons was studied under the impulse approximation, and explicit expressions for the cross sections for elastic, inelastic, and charge exchange scatterings were obtained using the Chew-Low amplitude for pion-nucleon scattering. Numerical calculations were carried out, and comparison was made with experimental results. (auth)

10835 CHARGE BRANCHING RATIOS FOR PERIPHERAL MESON-NUCLEON COLLISIONS. H. Pilkuhn (Univ. of Stockholm). Nuclear Phys., 29: 199-211(1962). (In English)

Charge branching ratios for one-meson and two-meson exchange graphs are considered, and coefficients for two-meson exchange graphs are calculated. (auth)

10836 THREE-PARTICLE PHOTO-DISINTEGRATION OF THE TRITON. L. M. Delves (Univ. of New South Wales, Kensington, Australia). Nuclear Phys., 29: 268-80(1962). (In English)

The cross section for the process $T(\gamma,nn)p$ is calculated for energies from 0 to 15 Mev above threshold using a representation of the three-particle states. The method is applicable to other photo-disintegration reactions leading to final states involving three or more free particles, and has the advantage that the final state interaction can be readily included. Coulomb effects can also be treated, leading to a suggested form for the threshold energy variation of reactions involving three or more charged particles in the final state. (auth)

10837 DISTORTED WAVE APPROXIMATION FOR TENSOR FORCE INTERACTIONS. P. Swan (Univ. of Melbourne). Nuclear Phys., 29: 281-91(1962). (In English)

The distorted wave approximation previously used for central force scattering is extended to tensor forces for the n–p system. Integral equations for the tensor force scattering phase shifts $\eta_{j,j\pm1,M}$ in the coupled states $l = j \pm 1$

are first derived. On substitution of approximate analytical wave functions, these reduce to simultaneous equations in $\exp 2i\eta_{j,j\pm1,M}$, the phase-shifts being complex. The Born approximation for $\eta_{j,j\pm1,M}$ follows as a special case. Expressions for the ground state properties of the deuteron are also derived, including the binding energy, electric quadrupole moment and magnetic moment. A simplified example is given, in which the n–p potential is taken as a delta function with central and tensor force components, enabling comparison of exact and approximate results. (auth)

10838 ON THE HIGH-ENERGY LIMIT OF ORDINARY DISPERSION RELATIONS. H. Lehmann (Universität, Hamburg). Nuclear Phys., 29: 300-8(1962). (In English)

The connection between the high-energy behavior of real and imaginary parts of scattering amplitudes is studied on the basis of dispersion relations for fixed momentum transfer. (auth)

10839 INTEGRAL EQUATIONS FOR THE LOW-ENERGY PION-PION SCATTERING. A. Q. Sarker (Univ. of Birmingham, Eng.). Nuclear Phys., 29: 318-25(1962). (In English)

Integral equations for S and P amplitudes in π-π scattering are derived from a single-dispersion relation and its Taylor-series expansion in the forward and backward directions. It is shown that the same integral equations could also be obtained from the dispersion relation for fixed partial waves. In this derivation it is necessary to make further approximations besides keeping only S- and P-waves on the unphysical cut. Accuracy comparisons of the two methods of approximation are made, and it is concluded that, for certain cases at least, the approach using fixed partial waves is likely to yield better results. (auth)

10840 VARIATIONAL PRINCIPLES FOR MANY-CHANNEL SCATTERING SYSTEMS. L. M. Delves (Univ. of New South Wales, Kensington, Australia). Nuclear Phys., 29: 326-34(1962). (In English)

Variational principles are given for the scattering matrix describing arbitrarily complicated collisions of compound systems. These principles are stationary with respect to variations in the eigenfunctions of the scattered particles, a necessary condition if they are to be of practical use; in certain cases maximum or minimum properties are also proved. The first order perturbation theory for the problem is given. Results are given in a form valid at reaction thresholds. Coulomb effects are not treated. (auth)

10841 MULTIPLE PION PRODUCTION IN THE SUB-GeV REGION. S. K. Srinivasan (Indian Inst. of Tech., Madras) and K. Venkatesan. Nuclear Phys., 29: 335-40 (1962). (In English)

Production of double and triple pions in photo-nucleon and pion-nucleon collisions is examined in the light of the pion-pion interaction. It is found that, while a cut-off theory by itself explains photoproduction of pion pairs up to about 600 Mev, it is necessary to introduce the pion-pion interaction for higher energies, as well as for other processes like pion production in pion-nucleon collisions and triple photo-pion production. (auth)

10842 A COMMENT ON PRECISION MEASUREMENTS OF THE BINDING ENERGY OF THE DEUTERON. Jerry B. Marion (Univ. of Maryland, College Park). Nuclear Phys., 29: 341-4(1962). (In English)

A discussion is presented of the determination of the binding energy of the deuteron utilizing nuclear reaction and mass spectroscopic data. By combining the most precise values of the threshold energy for the $T(p,n)He^3$ reaction, the β-decay end-point energy of tritium and the H_2-D mass difference, the result for the binding energy of the deuteron is 2224.8 ± 0.5 kev. (auth)

10843 RADIATIVE CORRECTIONS TO THE ELECTRON POLARIZATION IN THE BETA-DECAY OF A FREE NEUTRON. Milan Vymazal (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Nuclear Phys., 29: 345-8(1962). (In English)

An expression for the electromagnetic radiative corrections of the order $\alpha (= 1/137)$ to the longitudinal polarization rate of the electron in the beta-decay of a free neutron is derived in the approximation $\Delta/M \ll 1$, where Δ is the neutron-proton mass difference and M the mass of the neutron. The corrections are not larger than 0.2% and it seems that they cannot explain the deviation of the experimental value for the electron polarization from the value $-v/c$ (measured in the beta-decay of nuclei). (auth)

10844 RELATIVE PARITIES OF BARYONS. Jerzy Rayski (Jagellonian Univ., Krakow). Nuclear Phys., 29: 349-51(1962). (In English)

An essentially improved interpretation of electrodynamics and baryon theory is given. New results for the most natural parity assignments are [particle (parity)]: $\pi(-)$, $K(+)$, $N(+)$, $\Lambda(\mp)$, $\Sigma(+)$, and $\Xi(+)$. The most plausible forms of strong interaction terms are given. (auth)

10845 ANGULAR DISTRIBUTION IN $\pi \rightarrow \mu + \nu$ DECAY. E. Frota-Pessoa and N. Margem (Centro Brasileiro de Pesquisas Físicas, Faculdade Nacional de Filosofia, Rio de Janeiro). Nuovo cimento (10), 21: Suppl. No. 1, 48-54(1961). (In English)

A study of angular distributions of 4 132 μ mesons resulting from π decay at rest in nuclear emulsions is made using area scanning, searching for μ-ends. The results are compared with others obtained in the same plates with area scanning, searching for π-μ vertices. Contrasting with previous results showing a strong backward-forward asymmetry, the present analysis gives no asymmetry. This is attributed to the strong reduction of bias against small π-μ angles in the μ-ending scanning. (auth)

10846 THE EFFECTS OF THE NUCLEAR CHARGE POLARIZATION ON THE ELASTIC SCATTERING. Y. N. Kim (Office of Atomic Energy, Seoul, S. Korea). Nuovo cimento (10), 22: 885-94(Dec. 1, 1961). (In English)

Effects of nuclear polarizability on elastic scattering of low-energy charged particles are discussed. The deviation from the Rutherford scattering due to the dipole polarizabilities is calculated. The effect of the quadrupole polarization in a strongly deformed nucleus is also examined. (auth)

10847 SEARCH FOR A MASS 550 PARTICLE. G. Monnig (Washington Univ., St. Louis). Nuovo cimento (10), 22: 895-903(Dec. 1, 1961). (In English)

The mass of sea-level cosmic particles was determined from simultaneous measurements of range, momentum, and Cherenkov light. No resolved measurements at about 550 m_e accompanied 448 stopping μ mesons. The likelihood of a bona fide mass 550 particle not being resolved was estimated at not greater than 10^{-3}. (auth)

10848 THE PION SPECTRUM IN RADIATIVE HYPERON DECAY. S. Iwao and J. Leitner (Syracuse Univ., N. Y.). Nuovo cimento (10), 22: 904-13(Dec. 1, 1961). (In English)

Calculations of S. Barshay et al. (Phys. Rev., 114: 931 (1959)) on relative hyperon decay are extended to include the pion momentum spectra. Results show that radiative

hyperon decay will appear as an important source of background in the study of hyperon leptonic decay. (auth)

10849 ELECTROMAGNETIC PROPERTIES OF SUPERCONDUCTORS. V. Ambegaokar and L. P. Kadanoff (Univ. of Copenhagen). Nuovo cimento (10), 22: 914-35 (Dec. 1, 1961). (In English)

A method of calculating the response of superconductors to weak electromagnetic fields is formulated. The response is generated from a single-particle Green's function, defined in the presence of an electromagnetic perturbation, that satisfies the conditions imposed by gauge invariance and charge conservation. The response function is thus itself explicitly gauge invariant and charge conserving. The single-particle Green's function is obtained by making Gorkov's factorization of the two-particle Green's function in the presence of the external field. The symmetry properties of the approximation are used to simplify the calculation. This is trivially carried out in the London limit. An economical derivation is thus obtained of Anderson's result that the Bardeen, Cooper, and Schrieffer quasiparticle excitations must be supplemented by a collective excitation in order to satisfy the conservation laws. (auth)

10850 STATISTICAL THEORY OF MULTIPLE MESON PRODUCTION WITH ANGULAR MOMENTUM CONSERVATION. F. Cerulus (CERN, Geneva and Institut Interuniversitaire des Sciences Nucleaires, Brussels). Nuovo cimento (10), 22: 958-95(Dec. 1, 1961). (In English)

The conventional statistical theory (with energy-momentum but without angular momentum conservation) gives the same results (multiplicities and spectra) as obtained from a model assuming the existence of an intermediate "hot spot" in the collision of two high-energy particles, if the "hot-spot" formation is statistically independent of its decay into many particles. The model is suggested by the formulas used in statistical theory, which in effect put the probability to produce n particles proportional to the probability of finding n particles together in a volume Ω. Angular momentum conservation (together with energy and momentum conservation) can be satisfied by considering only states of n particles with prescribed values of total J, energy and momentum. By using the formalism of the density matrix and an explicit expression for the projection operators on states of given angular momentum, a modified form of the phase-space integral is obtained, which is simply related to the probability to produce n particles. The theory with angular momentum but without momentum conservation, as given by Koba, is shown to be a special case easily derivable from the present formalism. The "classical" theory of angular momentum conservation by Ericson is shown to be a limiting case of wide applicability, however. The conventional theory is valid only if all end particles are in s-states. The formulas were derived for a spherical Gaussian shape for Ω. Allowance for contracted shapes can be made. A Monte-Carlo program is proposed to evaluate this phase-space integral. The method will allow computation of spectra of the longitudinal and the transverse momenta of the final particles. The effect on multiplicity of J-conservation is evaluated. Compared to the conventional theory, multiplicity is increased by 10% in p-$\bar{p}$ annihilation and decreased by 10% in 6-Bev p-p collisions. (auth)

10851 A POSSIBLE MEANS TO OBTAIN EVIDENCE CONCERNING THE SPIN OF THE K'-MESON. B. T. Feld and D. B. Lichtenberg (CERN, Geneva). Nuovo cimento (10), 22: 996-1004(Dec. 1, 1961). (In English)

It is shown that $\bar{p}$-p annihilation at rest into a K' and $\overline{K'}$ can provide information about the spin of the K' if a number of assumptions are justified. These assumptions are: the K' has spin either zero or one; the annihilation occurs in an S-state; the K' and $\overline{K'}$ decay as free particles; the background of annihilation events which cannot be distinguished kinematically from $K'\overline{K'}$ production is small. The method consists in showing that if the K' has spin one, it is unlikely that the angular distributions will be isotropic with respect to all the angles specified by the production and decay of the K' and $\overline{K'}$. The degree of anisotropy is not unique. However, it would require a triple coincidence for isotropy; i.e., three relationships would have to hold among the parameters specifying the interaction. If the K' has spin zero, the angular distribution is of course isotropic. All of the assumptions are open to some question. Nevertheless, it may be possible to obtain some evidence about the spin of the K' from the angular distributions, even if the assumptions are false. (auth)

10852 A RELATIVISTIC SCATTERING MODEL SATISFYING UNITARITY, CROSSING SYMMETRY AND ANALYTICITY. N. N. Khuri (CERN, Geneva). Nuovo cimento (10), 22: 1023-38(Dec. 1, 1961). (In English)

A model is constructed which can generate a class of scattering amplitudes that have the same analytic properties as conventional perturbation theory, are crossing symmetric, and satisfy the unitarity condition in the elastic region in all three channels. The model consists of a nonlinear off-shell integral equation whose solution gives a different amplitude for each different first order term or "generalized potential" started. The main new condition on these "potentials" is that they cannot have elastic cuts in any channel. The relation of this model to the problem of the uniqueness of the Chew-Mandelstam program is discussed. (auth)

10853 A NEW LIMIT TO THE ELECTRIC DIPOLE MOMENT OF THE MUON. G. Charpak, F. J. M. Farley, R. L. Garwin, T. Muller, J. C. Sens, and A. Zichichi (CERN, Geneva). Nuovo cimento (10), 22: 1043-50(Dec. 1, 1961). (In English)

By storing polarized positive muons in a magnetic field for as many as 1200 revolutions, a new upper limit to the electric dipole moment is determined. The value is $EDM \leq (3 \pm 6) \times 10^{-5} \cdot (eh/mc)$ or $EDM \leq e \times (0.6 \pm 1.1) \times 10^{-17}$ cm, consistent with time-reversal invariance. (auth)

10854 Λ^0's FROM K^- CAPTURE IN EMULSION. R. Cester (Istituto Nazionale di Fisica Nucleare, Turin), G. Ciocchetti, A. Debenedetti, A. Marzari Chiesa, G. Rinaudo, C. Deney, K. Gottstein, and W. Pueschel. Nuovo cimento (10), 22: 1069-86(Dec. 1, 1961). (In English)

The energy distribution of Λ^0 from K capture stars was obtained measuring Λ^0 found by area scanning in two emulsion stacks. This distribution, compared to a theoretical one obtained with an optical model calculation, gives indication that the percentage of multi-nucleon captures in emulsions is about 30%. Detailed study of 103 capture stars correlated to Λ^0 decay leads to the same conclusion. From the study of the missing energy in K^- capture stars it is deduced that the probability for absorption of a π^0 in nuclear matter is very low. There is evidence that the probability for emission of a Λ^0 is not strongly dependent on the atomic weight of the nucleus in which the K^- was absorbed. The upper limit for cryptofragment formation is 15%. Due to the low statistics, a search for the formation of Y_1^{*-} in the reaction $K^- + 2n \rightarrow Y_1^{*-} + n$ of a K^- at rest in the emulsion nuclei gives no conclusive result. (auth)

10855 ANALYSIS OF 1347 τ^- DECAYS. M. Ferro-Luzzi, D. H. Miller, J. J. Murray, A. H. Rosenfeld, and

R. D. Tripp (Univ. of California, Berkeley). Nuovo cimento (10), 22: 1087-92(Dec. 1, 1961). (UCRL-9798). (In English)

Decay modes of $K^-_{\mu 3}$ were studied using a homogeneous sample of 1347 K^- decaying in flight in a bubble chamber. Momenta varied between 300 and 850 Mev/c. A Dalitz plot of π energy distributions is presented. Matrix angular and energy dependence data are presented in graphical form. (L.N.N.)

10856 SOME REMARKS ON THE FEYNMAN-GELL-MANN FORMULATION OF THE FERMI INTERACTION. L. C. Biedenharn (Duke Univ., Durham, N. C.). Nuovo cimento (10), 22: 1097-8(Dec. 1, 1961). (In English)

Consequences of the Feynman–Gell-Mann (F.-G.) proposal (R. P. Feynman and M. Gell-Mann, Phys. Rev., 109: 193(1958)) are discussed for β decay in the presence of an external Coulomb field (α Z/r). The iterated equation derived possesses two additional commuting operators over the Dirac equation. It is shown that the relativistic Dirac-Coulomb (radial) wave functions appropriate to the F.-G. two-component formulation are precise analogues to the non-relativistic Coulomb wave functions. Parity is re-introduced, and parity mixing occurs only for the cases in which M = 0 or α Z ± 0. (L.N.N.)

10857 SOME REMARKS ON DOUBLE PHOTOPRODUCTION. D. Boccaletti (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 22: 1099-1103(Dec. 1, 1961). (In English)

Total cross sections for $\gamma + p \rightarrow p + \pi^+ + \pi^-$ are calculated using the Drell diagram (S. D. Drell, Phys. Rev. Lett. 5: 278(1960)). The maximum value is at 1.2 Bev and is about 10 μb, whereas the experimental value is about 80 μb. It is concluded that at above 0.9 Bev, the Boccaletti-Gualdi diagram (D. Boccaletti and C. Gualdi, Nuovo cimento, 18: 895(1960)) becomes of primary importance. Evidence for the Drell effect should instead be expected in favorable kinematical conditions. (L.N.N.)

10858 SOME CONSIDERATIONS OF ANALYTICITY IN THE MANY-FERMION PROBLEM. J. S. Langer (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 124: 997-1003(Nov. 15, 1961).

The analytic properties of Feynman amplitudes in the many-fermion problem are investigated using techniques developed for field theory. A prescription is given for calculation of discontinuities across branch cuts. This prescription leads to a reformulation of the theory in terms of quasi-particles, but considerations of unitarity are no longer so simple as they are in field theories dealing with stable particles. These analytic methods are useful in electron transport problems. (auth)

10859 MEAN LIVES OF POSITRONS IN OXIDIZING SOLUTIONS. John D. McGervey, Henry Horstman, and Sergio DeBenedetti (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 124: 1113-16(Nov. 15, 1961).

Positron mean lives were measured in aqueous chloride solutions to detect positronium (Ps) oxidation by positive ions. The variation of mean life with concentration and with oxidation potential of the positive ion shows that Ps is oxidized by solutions of $SnCl_4$ and $HgCl_2$, but not by HCl or solutions of ions with lower oxidation potentials. These results indicate that the process is similar to the ordinary chemical oxidation process. (auth)

10860 ESTIMATE OF THE NUCLEON MASS DIFFERENCE FROM HOFSTADTER'S NEW FORM FACTORS. H. Katsumori and M. Shimada (Osaka Univ.). Phys. Rev. 124: 1203-4(Nov. 15, 1961).

It is shown that the set of isotopic form factors proposed by Hofstadter and Herman (R. Hofstadter and R. Herman, Phys. Rev. Let. 6: 293(1961)) seems favorable for an explanation of the observed nucleon mass difference in terms of the electromagnetic self-energy, if an extended core radius is suitably introduced. (auth)

10861 DECAY MEASUREMENTS IN EMULSION ON PARTICLES OF NEGATIVE STRANGENESS. Walter H. Barkas, John N. Dyer, Conrad J. Mason, Norris A. Nickols, and Frances M. Smith (Univ. of California, Berkeley). Phys. Rev. 124: 1209-23(Nov. 15, 1961).

Results of measurements on decay processes of K^- mesons, Λ hyperons, and charged Σ hyperons are reported. Experimental and analytical techniques are outlined. The abundances of the K^--meson decay modes were found to be $K^-_{\mu 2}$ (56.5 ± 7.3%), $K^-_{\mu 3}$ (9.5 ± 4.3%), $K^-_{\pi 2}$ (26.3 ± 6.6%), τ^-(0 + 2.1%), τ'^-(2.8 ± 2.4%), and K^-_{e3} (4.9 ± 3.2%). The mean life of the K^- meson is $(1.25^{+0.22}_{-0.17}) \times 10^{-8}$ sec. Measurements on 116 Λ-hyperon decay events in two emulsion stacks determined the Λ-hyperon mass to be 1115.36 ± 0.14 Mev, using 938.213 Mev and 139.59 ± 0.05 Mev for the proton and pion masses. The Q value derived from these masses is 37.56 ± 0.13 Mev. In an analysis of about 200 hyperfragment decays, no leptonic modes of bound Λ hyperons were observed. Some 390 charged Σ-hyperon decay events were studied. The proton range from the mode $\Sigma^+ \rightarrow p + \pi^0$ is 1677.5 ± 3.2 μ, corresponding to 189.01 ± 0.20 Mev/c. The mass of the Σ^+ hyperon from this measurement is 1189.33 ± 0.22 Mev. From the decay mode $\Sigma^+ \rightarrow n + \pi^+$, the π^+ range is 92.48 ± 0.49 mm, corresponding to 184.44 ± 0.55 Mev/c, and a Σ^+ mass of 1188.75 ± 0.54 Mev. If the mass of the neutral particle in the proton decay mode is considered unknown, these measurements imply a mass of 134.0 ± 1.0 Mev for it, consistent with the π^0 mass of 135.0 ± 0.05 Mev. Studies of the hyperon mean-lives gave, for the Σ^+ hyperon, $(0.82^{+0.10}_{-0.08}) \times 10^{-10}$ sec, and for the Σ^- hyperon, $(1.75^{+0.32}_{-0.30}) \times 10^{-10}$ sec. Reasons for experimental biases that affected emulsion measurements are discussed. The branching ratio $\Sigma^+ \rightarrow (p + \pi^0)$/(all Σ^+ decay) was 0.50 ± 0.03. No example of the decay mode $\Sigma^+ \rightarrow p + \gamma$ was found in a sample of 95 $\Sigma^+ \rightarrow p$ decay events. No Σ^+ leptonic decay events were observed among 129 π^+ decays, nor any Σ^- leptonic modes among 67 π^- events. No up-down decay asymmetry was detected in any mode for charged hyperons emitted from complex nuclei in association with a charged pion. (auth)

10862 REGENERATION OF NEUTRAL K MESONS AND THEIR MASS DIFFERENCE. R. H. Good, R. P. Matsen, F. Muller, O. Piccioni, W. M. Powell, H. S. White, W. B. Fowler, and R. W. Birge (Univ. of California, Berkeley). Phys. Rev. 124: 1223-39(Nov. 15, 1961).

A beam of K_2 mesons was produced by passing a beam of 1.1-Bev/c negative pions through a liquid hydrogen target and accepting the neutral reaction products in the forward direction after allowing the K_1 component to decay. The resultant beam was observed in a 30-in. propane bubble chamber fitted with lead and iron plates. About 200 regenerated K_1 mesons were identified by their characteristic Q value and decay rate. All three types of regeneration were observed: by transmission in the plates, by nuclear diffraction, and by interaction with single nucleons. The detection of the first two types of regeneration constitutes strong evidence for the correctness of the Gell-Mann and Pais particle mixture theory. Comparison of the transmission and diffraction regeneration effect gives the K_1-K_2 mass difference δ. Corrections must be applied: one originates from the nuclear scattering of the trans-

mission component, the other from the multiplicity of scatterings in a thick plate. The independence from nuclear parameters is no longer rigorously valid; but due to the sharp dependence of the transmission intensity upon the mass difference, the nuclear properties of K^0 and $\bar{K}^0$, as derived from K^+ and K^- data, still allow a measurement of δ. It is found that δ is $0.84^{+0.29}_{-0.22}$ in units of $\hbar/\tau_1$, where τ_1 is the K_1 mean lifetime. With 90% confidence level, the difference is between 0.44 and 1.2 $\hbar/\tau_1$. The probability that the transmission peak is due to a statistical fluctuation is one in a million. (auth)

10863 BIPIONIC DECAY OF K'. Akihiko Fujii (Imperial Coll. of Science and Tech., London). Phys. Rev. 124: 1240 (Nov. 15, 1961).

The branching ratio of the bipionic decay of the K' particle, $w(K' \to K + 2\pi)/w(K' \to K + \pi)$, is calculated in Fermi's statistical theory. This ratio is a few percent using a reasonable choice of the interaction range. (auth)

10864 DISPERSION RELATIONS FOR PRODUCTION AMPLITUDES. [PART] I. Y. S. Kim (Princeton Univ., N. J.). Phys. Rev. 124: 1241-8 (Nov. 15, 1961).

Problems of spectral representation are investigated for processes in which a nucleon collides with a boson resulting in a single nucleon and two bosons. The kinematical system proposed by Polkinghorne, Kibble, and Logunov is simplified and Lorentz-generalized. For the double Compton effect, an alternative proof is given for the dispersion relation originally derived by Logunov, Bilenkiz, and Tavkhelidze. Also for the double Compton effect, two other single-variable dispersion relations are shown to be valid. (auth)

10865 LOW-ENERGY PION-PHOTON INTERACTION: THE $(2\pi,2\gamma)$ VERTEX. Bipin R. Desai (Univ. of California, Berkeley). Phys. Rev. 124: 1248-57 (Nov. 15, 1961).

In the $(2\pi,2\gamma)$ problem, the Mandelstam representation is written for the two independent gauge-invariant amplitudes. On the basis of unitarity limitations on the asymptotic behavior of these amplitudes, only a $j = 1$ subtraction in the $\gamma + \pi \to \gamma + \pi$ channel and a $j = 0$ subtraction in the $\gamma + \gamma \to \pi + \pi$ channel are allowed. No over-all subtraction constants are required and the Thomson limit is automatically maintained. Only the effect of 2π intermediate states is considered. The odd-j $\pi\pi$ contribution involves the amplitude for the process $\gamma + \pi \to 2\pi$ analyzed by Wong and shown to be proportional to a pseudo-elementary constant Λ. Even with a $\pi\pi$ P resonance, the correction is negligible ($\lesssim 1\%$) if the value of Λ estimated by Wong on the basis of π^0 decay and confirmed by Ball in connection with photopion production on nucleons is used. A moderately important contribution comes from the S-wave interaction if a recent estimate of $\pi\pi$ S-wave phase shifts obtained from crossing relations. For the pion-pion coupling constant λ of order -0.20, this effect is $\sim 10\%$ in $\gamma + \pi \to \gamma + \pi$ scattering. For $\gamma + \gamma \to \pi + \pi$, the correction for the $I = 0$ state at threshold is positive and $\sim 100\%$ of the Born approximation. However, as the energy is increased, the correction quickly changes sign. (auth)

10866 ELEMENTARY AND COMPOSITE PARTICLES. M. T. Vaughn, R. Aaron, and R. D. Amado (Univ. of Pennsylvania, Philadelphia). Phys. Rev. 124: 1258-68 (Nov. 15, 1961).

It is shown for two simple fixed-source theories with one stable excited state of the source that (1) a knowledge of the physical S-matrix elements of the theory is sufficient to decide if the state is associated with an elementary particle or a composite particle, and (2) the theory in which the particle is composite corresponds to the elementary-particle theory in the limit of vanishing wave function renormalization constant of the elementary particle. The distinction between elementary and composite particle is related to a generalization of Levinson's theorem, and it is made plausible that this generalization is valid in local field theory. The result (2) is generalized, and an application to the dispersion-theoretic treatment of rearrangement collisions is suggested. (auth)

10867 BEHAVIOR OF NUCLEON-NUCLEON SINGLET PHASE SHIFTS. Daniel M. Greenberger and B. Margolis (Ohio State Univ., Columbus). Phys. Rev. 124: 1269-73 (Nov. 15, 1961).

By applying a conformal mapping to the partial wave scattering amplitudes, it is possible to confine the entire unphysical branch cut in the amplitude to a compact region. This allows introduction of a set of expansion functions for approximating the behavior of the amplitude in the physical region. Using these functions, the observed energy dependence of the phase shifts are correlated with that of the imaginary part of the amplitude along the unphysical cut. In this way it is shown that the $^1S_0$ energy dependence seems to require a short-range repulsive core. The attractive long-range forces tend to give a positive shape parameter and the hard core a negative one, so the actual sign can go either way. A two-parameter $^1S_0$ fit up to 300 Mev and for the $^1D_2$ phase shift a one-parameter fit accurate between 40 and 250 Mev are presented. Inelastic scattering is small below 250 Mev, and also that a good fit to scattering data up to 250 Mev does not accurately determine the behavior of the amplitude in the unphysical region. (auth)

10868 LIFETIME OF THE Σ^0. J. Dreitlein and B. W. Lee (Univ. of Pennsylvania, Philadelphia). Phys. Rev. 124: 1274-80 (Nov. 15, 1961).

A dispersion-theoretic calculation of the lifetime of the Σ^0 is carried out along lines suggested by previous treatments of the nucleon electromagnetic form factors. In terms of the coupling constants of the Σ, Λ, and N baryons to the pion (g_Λ, g_Σ, and g), the Σ^0 lifetime is predicted to be $\tau = (g_\Sigma g_\Lambda/g^2)^{-2} \times 1.1 \times 10^{-19}$ sec, irrespective of the relative (Λ,Σ) parity, the validity of this expression depending on the dominance of the two-pion resonating state contribution to the $\Sigma^0 \to \Lambda + \gamma$ transition magnetic moment. (auth)

10869 ON THE PROOF OF PARAMETRIC DISPERSION RELATIONS. H. M. Fried and D. L. Pursey (Univ. of California, Los Angeles). Phys. Rev. 124: 1281-2 (Nov. 15, 1961).

Parametric dispersion relations for the connected time-ordered Green's functions, conjectured on the basis of perturbation theory, are shown to exist for the special case of decay processes. Extension of the proof to scattering and production depends upon the possibility of continuing one or more of the energy variables to negative values. (auth)

10870 INTERMEDIATE MESON CONTRIBUTIONS TO HYPERON DECAYS. David R. Harrington (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. 124: 1290-6 (Nov. 15, 1961).

Dispersion relations were used to estimate the contributions to Λ and Σ hyperon decays from one- and two-meson intermediate states for both even and odd $\Lambda-\Sigma$ relative parity. Results indicate that these contributions have a negligible effect on the electron modes and perhaps give a 10% correction to the rates for the muon modes; the lepton decay modes are apparently dominated by the V and A form factors at zero momentum transfer which appears as sub-

traction constants in the calculations. For even $\Lambda-\Sigma$ parity the two-meson contributions to the pion mode amplitudes are roughly 20% of the experimental values. The contributions to the Λ-decay amplitudes are essentially unchanged when odd $\Lambda-\Sigma$ parity is assumed, but the contributions to the Σ amplitudes are reduced to about 6% of the experimental values. (auth)

10871 STRAGGLING EFFECTS ON RESONANT YIELDS. H. W. Lewis (Princeton Univ., N. J.). Phys. Rev., 125: 937-40(Feb. 1, 1962).

The finite nature of energy loss processes for a charged particle in a material leads to a "ringing" effect in the thick-target yield curve. The effect is described and evaluated. (auth)

10872 POLARIZATION OF PROTONS IN $C^{12}(d,p)C^{13}$. R. G. Allas and F. B. Shull (Washington Univ., St. Louis). Phys. Rev., 125: 941(Feb. 1, 1962).

Measurement of polarization of protons from the $C^{12}(d,p)C^{13}$ ground-state reaction was conducted. The values obtained are -42% at 42.5° (lab); -35.4% at 46°; -51.5% at 52°; -22.5% at 61.5°; -20% at 64.5°; -6% at 70°; $+35\%$ at 76°. The axis of quantization is taken as $n = k_d \times k_p$. (auth)

10873 n-p TRIPLE SCATTERING PARAMETERS R AND A. R. A. Hoffman, J. Lefrançois, E. H. Thorndike, and Richard Wilson (Harvard Univ., Cambridge, Mass.). Phys. Rev., 125: 973-4(Feb. 1, 1962).

The parameters R and A were measured for scattering of 140-Mev polarized protons by neutrons bound in deuterium (quasi-free p-n scattering). Corrections relating these results to the free n-p parameters were applied, and the following values obtained:

θ_{cm}	R_{np}	A_{np}
42.1°	0.228 ± 0.119	−0.037 ± 0.094
52.5°	0.090 ± 0.094	0.080 ± 0.074
62.9°	−0.012 ± 0.075	0.226 ± 0.090
73.4°	−0.147 ± 0.095	0.137 ± 0.107
83.6°	−0.147 ± 0.210	0.535 ± 0.222

(auth)

10874 FUNDAMENTAL CONSTANTS OF THE MUON. G. Shapiro and L. M. Lederman (Columbia Univ., New York). Phys. Rev., 125: 1022-3(Feb. 1, 1962).

Three precise measurements exist on static properties of the muon. These are the g factor, g-2, and the frequency of the 3D-2P transition in mesonic phosphorus. They are combined to obtain the best fit to the fundamental constants of the muon. (auth)

10875 DECAY OF NEUTRON PIONS. Hla Shwe, Frances M. Smith, and Walter H. Barkas (Univ. of California, Berkeley). Phys. Rev., 125: 1024-7(Feb. 1, 1962).

The proper mean life of the neutral pion is measured utilizing a large relativistic time dilation. Negative pions of 3.5 Bev were permitted to interact in K-5 nuclear emulsions. High-energy neutral pions from some 2000 interaction stars were observed when they decayed by the Dalitz mode. The distances from the star centers at which they decayed were accurately measurable. The momentum spectrum of the neutral pions was assumed to be the same as that of the charged pions produced in the same interactions. Angular distributions of the secondary charged and neutral pions are presented separately. The mean transverse momentum of the charged pions was measured and found to be 250 ± 10 Mev/c. The neutral pion mean life is $(1.9^{+\,1.2}_{-\,0.8}) \times 10^{-16}$ sec. (auth)

10876 DEPOLARIZATION IN 212-Mev QUASI-ELASTIC p-n SCATTERING. Robert E. Warner and John H. Tinlot (Univ. of Rochester, N. Y.). Phys. Rev., 125: 1028-33 (Feb. 1, 1962). (NYO-9451)

The triple scattering parameter D for 212-Mev quasi-elastic p-n scattering from deuterium was measured at c.m. angles of 40, 50, 60, 70, and 80°. Protons and recoil neutrons from a liquid deuterium target were detected in coincidence. The experimental results are compared with theoretical predictions. (auth)

10877 STRANGE PARTICLE PRODUCTION IN PROTON-PROTON COLLISIONS. Tsu Yao (Columbia Univ., New York). Phys. Rev., 125: 1048-54(Feb. 1, 1962).

An estimate is made for strange particle production in p-p collisions based on the single pion exchange model. For the three-particle final state (KYN), fair agreement with experiment is achieved in both the total cross sections and the momentum and angular distributions of the final particles. For the four-particle final state (KYNπ), general qualitative agreement is achieved for all total cross sections but one. In this, the case of $\pi^0 + p + K^+ + \Lambda^0(\Sigma^0)$ production, it is suggested that perhaps Y^* production in p-p collisions plays an important role. (auth)

10878 CAN MASSLESS PARTICLES BE CHARGED? K. M. Case and S. G. Gasiorowicz (Univ. of California, Berkeley). Phys. Rev., 125: 1055-8(Feb. 1, 1962). (UCRL-9811).

It is shown that for particles of spin one or larger, Lorentz invariance, masslessness, and conventional electromagnetic coupling are mutually incompatible. (auth)

10879 PION-PION SCATTERING AND LOW-ENERGY PION PRODUCTION. Howard J. Schnitzer (Univ. of Rochester, N. Y.). Phys. Rev., 125: 1059-61(Feb. 1, 1962).

A model for the reaction $\pi + N \rightarrow 2\pi + N$ at low energies, with $\pi-\pi$ scattering lengths as parameters is extended by removing the assumption that $a_0/a_2 = 5/2$. The parameters are determined by using the π^+ angular distribution from $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ at 430 Mev and the total cross section for $\pi^+ + p \rightarrow \pi^+ + \pi^+ + n$ at 470 Mev. Two acceptable sets for the $\pi-\pi$ scattering lengths are found: $a_0 = 0.50\ \mu^{-1}$, $a_1 = 0.07\ \mu^{-1}$, $a_2 = 0.16\ \mu^{-1}$ and $a_0 = 0.65\ \mu^{-1}$, $a_1 = 0.07\ \mu^{-1}$, $a_2 = -0.14\ \mu^{-1}$. The total cross sections for the charge channel and for single partial waves are computed. Predictions of the model are in qualitative agreement with experiment. (auth)

10880 SYMMETRIES OF BARYONS AND MESONS. Murray Gell-Mann (California Inst. of Tech., Pasadena). Phys. Rev., 125: 1067-84(Feb. 1, 1962).

The system of strongly interacting particles is discussed, with electromagnetism, weak interactions, and gravitation considered as perturbations. The electric current j_α, the weak current J_α, and the gravitational tensor $\theta_{\alpha\beta}$ are all well-defined operators, with finite matrix elements obeying dispersion relations. To the extent that the dispersion relations for matrix elements of these operators between the vacuum and other states are highly convergent and dominated by contributions from intermediate one-meson states, relations like the Goldberger-Treiman formula and universality principles like that of Sakurai according to which the ρ meson is coupled approximately to the isotopic spin exist. Homogeneous linear dispersion relations, even without subtractions, do not suffice to fix the scale of these matrix elements; in particular, for the nonconserved currents, the renormalization factors cannot be calculated, and the universality of strength of the weak interactions is undefined. More information than just the dispersion rela-

tions must be supplied, for example, by field-theoretic models; the equal-time commutation relations of the various parts of j_4 and J_4 are considered. These nonlinear relations define an algebraic system (or a group) that underlies the structure of baryons and mesons. It is suggested that the group is in fact U(3) × U(3), exemplified by the symmetrical Sakata model. The Hamiltonian density θ_{44} is not completely invariant under the group; the noninvariant part transforms according to a particular representation of the group; it is possible that this information also is given correctly by the symmetrical Sakata model. Exact relations among form factors follow from the algebraic structure. In addition, the approximate situation in which the strangeness-changing vector currents are conserved and the Hamiltonian is invariant under U(3) is considered; refering to this limiting case as "unitary symmetry." In the limit, the baryons and mesons form degenerate supermultiplets, which break up into isotopic multiplets when the symmetry-breaking term in the Hamiltonian is "turned on." The mesons are expected to form unitary singlets and octets; each octet breaks up into a triplet, a singlet, and a pair of strange doublets. The known pseudoscalar and vector mesons fit this pattern if there exists also an isotopic singlet pseudoscalar meson x^0. If unitary symmetry in the abstract is considered rather than in connection with a field theory, then, as an alternative to the Sakata model, the scheme of Ne'eman and Gell-Mann is four, which is called the "eightfold way"; the baryons N, Λ, Σ, and Ξ form an octet, like the vector and pseudoscalar meson octets, in the limit of unitary symmetry. Although the violations of unitary symmetry must be quite large, there is a possibility of relating certain violations to others. As an example of the methods advocated, a rough calculation of the rate of $K^+ \to \mu^+ + \nu$ in terms of that of $\pi^+ \to \mu^+ + \nu$ is presented. (auth)

10881 NEW FORMULATION OF DISPERSION RELATIONS FOR POTENTIAL SCATTERING. Daniel I. Fivel (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 125: 1085-7(Feb. 1, 1962).

The amplitude for Yukawa potential scattering is represented by a Watson-Sommerfeld integral over Legendre functions $P_{ip-\frac{1}{2}}$, p real. A dispersion relation and unitarity condition are given for the amplitudes appearing in this integral and it is shown that the resulting system for iterative calculation of the amplitude from the Born approximation is considerably simpler than in other formulations. It is also shown that these amplitudes behave similarly to the partial waves on the second energy sheet. (auth)

10882 BOSON PHOTOPRODUCTION EXPERIMENTS. Michael J. Moravcsik (Univ. of California, Livermore). Phys. Rev., 125: 1088-93(Feb. 1, 1962). (UCRL-6543-T)

A general discussion is presented of all possible experiments on photoproduction of spin-zero bosons from spin-$\frac{1}{2}$ fermions. Both scalar and pseudoscalar bosons are considered. The M matrix is constructed in terms of four invariants. There are altogether 64 different experiments possible. Of these, 16 are needed to measure all the bilinear combinations of the coefficients of the invariants in the M matrix. To determine the coefficients themselves (not necessarily unambiguously) seven experiments have to be carried out. The 64 observables are given in terms of the bilinear combinations of the coefficients. A list of experiments is then given, each of which determines the parity of the boson participating in the process. All of these experiments require polarized photon sources, and even the simplest one requires the measurement of recoil fermion polarization and the use of a polarized target, although not simultaneously. Sets of seven experiments are then constructed to determine the four coefficients in the M matrix. The simplest of these sets implies the same experimental requirements as the simplest parity experiment. The simplest set of 16 experiments giving all bilinear combinations of the coefficients involves in addition also simultaneously recoil nucleon polarization measurements and the use of polarized targets. (auth)

10883 QUASI-CLASSICAL THEORY OF THE NONSPINNING ELECTRON. Ralph Schiller (Syracuse Univ., N. Y.). Phys. Rev., 125: 1100-8(Feb. 1, 1962).

A modified Hamiltonian-Jacobi theory of classical mechanics following the work of Van Vleck. This modified Hamiltonian-Jacobi theory, or quasi-classical theory, permits an exhibition in classical mechanics many features that in the past were exclusively associated with quantum mechanics. Classical wave functions, classical operators, classical "eigenvalue" equations, a classical "sum over paths" formulation of classical mechanics, and classical creation and destruction operators are discussed. Following Van Vleck, the WKB approximate solutions to the Schrödinger equation can be derived from the solutions of the classical Hamilton-Jacobi equation. If the methods of Keller are applied to the nonrelativistic and relativistic Kepler problem, eigenvalues are derived from the requirement of single-valuedness imposed on the WKB soultions. The energy eigenvalues are those given by the Schrödinger equation and the Klein-Gordon equation, respectively. In the particular case of the harmonic oscillator there exists a canonical transformation which transforms the quasi-classical equation into an exact equation of quantum mechanics. It is suggested that if the WKB approximation and the Schrödinger equation predict the same eigenvalues, then there always exists a canonical transformation transforming the quasi-classical equation into the corresponding Schrödinger equation. Finally, the quasi-classical equations are derived in momentum space. (auth)

10884 QUASI-CLASSICAL TRANSFORMATION THEORY. Ralph Schiller (Syracuse Univ., N. Y.). Phys. Rev., 125: 1109-15(Feb. 1, 1962).

The quasi-classical theory is the theory of the WKB approximation as defined by Van Vleck. This approximate wave theory is invariant under canonical transformations. Transformation laws for wave functions and operators in this theory are derived. The connection problem of the ordinary configuration space is discussed from the point of view of Van Vleck. The usual method of WKB quantization is then contrasted with another method of quantization in a classic configuration space of creation and destruction operators. In this new configuration space it is found that, for some problems, the quasi-classical soultions are exact solutions of the Schrödinger equation. Finally, it is shown that the canonical transformations of the quasi-classical theory may be put into one-to-one correspondence with a group of approximate unitary transformations. (auth)

10885 HYPERFINE STRUCTURE OF MUONIUM. K. Ziock, V. W. Hughes, R. Prepost, J. Bailey, and W. Cleland (Yale Univ., New Haven). Phys. Rev. Letters, 8: 103-5(Feb. 1, 1962).

An induced microwave transition was observed between the two hyperfine structure magnetic substates of muonium designated by their strong-field quantum numbers (m_J, m_μ) $(\frac{1}{2}, \frac{1}{2}) \leftrightarrow (\frac{1}{2}, -\frac{1}{2})$, where m_J and m_μ are the magnetic quantum numbers of the electron and the muon. The transition is observed under approximately strong-field conditions for which the transition frequency is roughly $\Delta\nu/2$. From the observed resonance condition of microwave fre-

quency and static magnetic field, $\Delta\nu$ is calculated exactly, using the Breit-Rabi formula. Parity nonconservation is observed in π and μ decay. The μ spin state is determined, and observations of induced transitions between different μ spin states are made. (L.N.N.)

10886 ALTERNATIVE NUCLEON FORM FACTORS. L. N. Hand, D. G. Miller, and R. Wilson (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters, 8: 110-12(Feb. 1, 1962).

A set of form factors G_E and G_M to describe electron scattering data is proposed. Error correlations are reduced, and scattering with spin flip is separated from that without. It is suggested that dispersion theory relates this with the same separation in other physical situations. The fit to G_{MV} includes the ρ meson and a core and leads to a diffraction minimum in electron scattering between 40 and 80 fermi^{-2}. The two-photon exchange becomes dominant at 40 fermi^{-2}, and the recoil proton should then be polarized with the polarization changing sign at the minimum. (L.N.N.)

10887 DECAY MODES AND WIDTH OF THE η MESON. Pierre L. Bastien, J. Peter Berge, Orin I. Dahl, Massimiliano Ferro-Luzzi, Donald H. Miller, Joseph J. Murray, Arthur H. Rosenfeld, and Mason B. Watson (Univ. of California, Berkeley). Phys. Rev. Letters, 8: 114-17(Feb. 1, 1962).

Events of the types $K^- + p \rightarrow \Lambda + \pi^+ + \pi^- + \pi^0$ and $K^- + p \rightarrow \Lambda$ + neutrals are considered; 606 such events produced by K^- mesons at 760 and 850 Mev/c were observed in a 15-in. bubble chamber. It is concluded from data obtained that $K^0_{\pi 2}$ production is involved in both reactions; the cross sections are 0.63 ± 0.11 and up to 0.04 mb at 760 and 850 Mev/c respectively. The branching ratios of charged to neutral $K^0_{\pi 2}$ decay is 0.31 ± 0.11 at 760 Mev/c. Results are consistent with quantum numbers 0^{-+} for the $K_{\pi 2}$, but the 1^{--} case cannot be ruled out with certainty. (L.N.N.)

10888 EVIDENCE THAT THE η MESON HAS ISOSPIN ZERO. D. Duane Carmony, Arthur H. Rosenfeld, and Remy T. Van de Walle (Univ. of California, Berkeley). Phys. Rev. Letters, 8: 117-19(Feb. 1, 1962). (UCRL-9978)

From the reaction $K^- + p \rightarrow \Lambda + K^0_{\pi 2}$, it was shown that $K_{\pi 2}$ can only have isospin 0 or 1 (P. L. Bastien et al., Phys. Rev. Letters, 8: 114(1962)). The case in which I = 1 is ruled out, and it is postulated that $K_{\pi 2}$ is an isospin triplet: $K^+_{\pi 2}$, $K^0_{\pi 2}$, $K^-_{\pi 2}$. (L.N.N.)

10889 SEARCH FOR THE DECAY MODE: $\mu \rightarrow e + \gamma$. D. Bartlett, S. Devons, and A. M. Sachs (Columbia Univ., New York). Phys. Rev. Letters, 8: 120-3(Feb. 1, 1962).

A search for the decay mode $\mu \rightarrow e + \gamma$ using spark chamber techniques is reported. Limits for the rate are less than 6×10^{-8} of the normal decay rate. (L.N.N.)

10890 NEW LIMIT ON THE $e + \gamma$ DECAY MODE OF THE MUON. S. Frankel (Univ. of Pennsylvania, Philadelphia), J. Halpern, L. Holloway, W. Wales, M. Yearian, O. Chamberlain, A. Lemonick, and F. M. Pipkin. Phys. Rev. Letters, 8: 123-5(Feb. 1, 1962).

Limits for the decay mode $\mu \rightarrow e + \gamma$ are studied using spark chamber techniques. A rate of less than 1.9×10^{-7} of the normal decay rate is the upper limit. (L.N.N.)

10891 SEARCH FOR CONVERSION OF MUONS INTO ELECTRONS. M. Conversi (Università, Rome), L. di Lella, G. Penso, M. Toller, and C. Rubbia. Phys. Rev. Letters, 8: 125-7(Feb. 1, 1962).

An investigation of the possible existence of the process $\mu^- + N = N + e^-$ is conducted from both the theoretical and the experimental point of view. Experimental equipment includes a monitoring telescope for the incoming μ^-, a spark chamber where the μ^- are brought to rest, and a telescope for the outgoing electrons. Electron energies are measured. Branching ratios are evaluated at 90 to 110 Mev, and over-all efficiencies are measured. If the process $\mu^- + N \rightarrow N + e^-$ exists at all, its branching ratio cannot exceed 2.4×10^{-7}. (L.N.N.)

10892 μ-MESONIC MOLECULES IN LIQUID HYDROGEN. E. Bleser, L. Lederman, J. Rosen, J. Rothberg, and E. Zavattini (Columbia Univ., New York). Phys. Rev. Letters, 8: 128-31(Feb. 1, 1962).

Muon catalysis of the reaction $p + d \rightarrow He^3 + Q$ (5.4 Mev) is studied in order to obtain information on the reaction $\mu^- + p \rightarrow n + \nu$ in liquid hydrogen. Observation of the molecular systems $p\mu p$ and $p\mu d$ and measurement of the fusion rate initiated in an s state are thus facilitated. The yield of fusion γ from pure hydrogen is measured as a function of time relative to μ stopping at six D concentrations. (L.N.N.)

10893 TEST OF CP CONSERVATION IN NEUTRAL K-MESON DECAY. R. G. Sachs (Univ. of Wisconsin, Madison) and S. B. Trieman. Phys. Rev. Letters, 8: 137-40(Feb. 1, 1962).

The charge-parity invariance of leptonic K^0 decay is studied. The reaction $K^0 \rightarrow \pi^- + e^+ + \nu$, for which $\Delta S = \Delta Q$ is considered, where ΔQ is the change in the electric charge and ΔS is the strangeness change. Tests for charge-parity invariance are proposed for strangeness-changing leptonic interactions. (L.N.N.)

10894 TESTS OF THE SINGLE-PION EXCHANGE MODEL. S. B. Trieman (Princeton Univ., N. J.) and C. N. Yang. Phys. Rev. Letters, 8: 140-1(Feb. 1, 1962).

Tests for fixed incoming energy are proposed for the single-pion exchange model. In interactions between particles p and k where p is at rest, the differential cross section should be invariant under the simultaneous rotation of all three-vectors $\vec{p}_i$ about the momentum vector $\vec{q}$ of the virtual meson. Similarly, where k is at rest, the differential cross section should be invariant under simultaneous rotation of all three-vectors $\vec{k}_i$ about $\vec{q}$. (L.N.N.)

10895 HIGH-ENERGY CROSS SECTIONS, POMERANCHUK THEOREMS, AND REGGE POLES. Bhaichandra M. Udgaonkar (Univ. of California, Berkeley). Phys. Rev. Letters, 8: 142-5(Feb. 1, 1962).

Following a proposal that the asymptotic behavior of the elastic scattering amplitude for any process is dominated by the Regge poles (J. Regge, Nuovo Cimento, 14: 951(1959); 18: 947(1960)) in the crossed channels, a theoretical framework is developed that prescribes minimum energies for the validity of the Pomeranchuk theorems (I. Ya. Pomeranchuk, Soviet Phys.-JETP, 7: 499(1958); L. B. Okun and I. Ya. Pomeranchuk, Soviet Phys.-JETP, 3: 307(1956)), rates at which the cross sections are to approach a constant limit, and how the differences of particle-antiparticle cross sections are to approach zero. The π^+-p cross sections are considered. (L.N.N.)

10896 P-WAVE PION-PION RESONANCE. B. H. Bransden (The University, Glasgow) and J. W. Moffat. Phys. Rev. Letters, 8: 145-7(Feb. 1, 1962).

Solutions of the coupled S and P wave amplitudes in π-π interactions (B. H. Bransden and J. W. Moffat, Nuovo Cimento, 21: 505(1961)) were obtained for the coupling constant $\lambda = -0.1$. Requirements of analyticity, unitarity, and crossing symmetry are satisfied at low energies. (L.N.N.)

10897 ELASTIC NUCLEON-NUCLEON SCATTERING AT HIGH ENERGIES AND SMALL ANGLES. K. Hiida

(Argonne National Lab., Ill.). Phys. Rev. Letters, 8: 148-50(Feb. 1, 1962).

Double diffraction scattering of a virtual boson by two nucleons is discussed as a mechanism explaining the characteristic cross-section feature $d\sigma_{lab}/d\Omega \approx (4\pi)^{-2} E_i^2 \sigma^2_{N\text{-}N}(E_i) \exp[-\alpha(-t)^{1/2}]$, where E_i is the energy of the incident proton in the laboratory system, $(-t)^{1/2}$ is the invariant momentum transfer, $\sigma_{N\text{-}N}(E_i)$ is the total cross-section for nucleon-nucleon interactions at E_i, and α is nearly constant but depends weakly on E_i and t. (L.N.N.)

10898 DECAY PRODUCTS OF VECTOR MESONS. G. Feinberg (Columbia Univ., New York). Phys. Rev. Letters, 8: 151-4(Feb. 1, 1962).

Partial widths for decay into different channels are calculated for η^0 and ω^0 mesons, with masses $m_\eta \sim 550$ Mev and $m_\omega \sim 790$ Mev. The matrix element is assumed to have the simplest form consistent with reported spin and parity assignments; final-state interactions are neglected; and all strong dimensionless coupling constants are evaluated by $g^2/4\pi = 1$. Vector meson decay modes are presented in tabular form. (L.N.N.)

10899 NEUTRAL DECAY MODES AND THE SPIN AND PARITY OF THE η MESON. Laurie M. Brown and Paul Singer (Northwestern Univ., Evanston, Ill.). Phys. Rev. Letters, 8: 155-6(Feb. 1, 1962).

The ratio $R_{V^0} = (V^0 \rightarrow \pi^0 + \gamma)/(V^0 \rightarrow \pi^+ + \pi^- + \pi^0)$ was calculated for η and ω mesons. It was assumed that the strong interaction vertex has the same form for both processes and corresponds to the simplest internal structure possible for a 1^- state of 3π. A regularization technique was applied to the π loop, yielding a result with logarithmic divergence which was cut off at the nucleon mass. The result is relatively insensitive to the cutoff and independent of the strength of the strong V^0 coupling. A similar method may also be applied to the ratio (for a 0^{-+} state) $\eta \rightarrow 2\gamma/\eta \rightarrow \pi^+ + \pi^- + \gamma$. (L.N.N.)

10900 TOTAL CROSS SECTIONS FOR PIONS ON PROTONS IN THE MOMENTUM RANGE 10 TO 20 Gev/c. G. von Dardel, D. Dekkers, R. Mermod, M. Vivargent, G. Weber, and K. Winter (CERN, Geneva). Phys. Rev. Letters, 8: 173-5(Feb. 15, 1962).

Total π^+-p cross sections at 10 to 20 Bev were measured using previous techniques (NSA, 15: 29935; 31307). Data are presented in graphical and tabular forms. Agreement with theory was obtained. (L.N.N.)

10901 DETERMINATION OF THE Σ PARITY. Robert D. Tripp, Mason B. Watson, and Massimiliano Ferro-Luzzi (Univ. of California, Berkeley). Phys. Rev. Letters, 8: 175-9(Feb. 15, 1962).

Angular distributions and polarizations of $\Sigma\pi$ charge states are studied. The transition operator parity in the reaction $K^- + p \rightarrow \Sigma + \pi$ is established, and it is concluded that the $K_p\Sigma$ parity is odd. Ambiguity (S. Minami, Progr. Theoret. Phys., 11: 213(1954)) data are presented in tabular form, and plots of momentum dependence of polarization terms and Σ^0, Σ^-, and Σ^+ angular distributions are given. (L.N.N.)

10902 HYPERCHARGE DEPENDENCE AT HIGH ENERGIES. V. Gupta (Tata Inst. of Fundamental Research, Bombay). Phys. Rev. Letters, 8: 180(Feb. 15, 1962).

High-energy limit theorems on the equality of particle and antiparticle cross sections for reactions with the same target and on the null charge-exchange cross section above about 10 Bev are considered. It is suggested that at such energies, N, Y, and Ξ form a triplet $\vec{F}$, and K, π, and $\bar{K}$ form the triplet $\vec{M}$, each with respect to hypercharge. The hypercharge spin U, so defined, is conserved. (L.N.N.)

10903 VIOLATION OF ISOTOPIC SPIN CONSERVATION IN THE DECAY OF EXCITED MESONIC STATES. Bernard T. Feld (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 8: 181-4(Feb. 15, 1962).

It is shown that a weak 2π decay of the ω is to be expected considering effects of electromagnetic interactions on ω decay. A quantitative estimate of the expected $2\pi/3\pi$ branching ratio is presented. A means of choosing an η spin assignment is provided. (L.N.N.)

10904 RADIATIVE CORRECTIONS TO PAIR ANNIHILATION TOTAL CROSS SECTION. G. Andreassi, P. Budini, and G. Furlan (Istituto Nazionale di Fisica Nucleare, Trieste, Italy and Università, Trieste, Italy). Phys. Rev. Letters, 8: 184-7(Feb. 15, 1962).

Radiative corrections to the total cross section for e^+-e^- annihilation are computed considering terms up to e^6. To obtain the real-photon contribution, a fictitious mass was inserted in the differential cross section for annihilation into 3 photons and then integrated to obtain the total cross section. Results are presented in tabular form. The corrected total cross section contains $\ln^2(2\gamma)$ terms. The origin of these terms is ascribed to the contribution of real, soft photons for small momentum transfer in the center-of-mass system. (L.N.N.)

10905 TOTAL CROSS SECTIONS AT HIGH ENERGIES. K. Hiida, M. Soga, and K. Tanaka (Argonne National Lab., Ill.). Phys. Rev. Letters, 8: 187-90(Feb. 15, 1962).

The relations $\sigma(\pi^-,p) > \sigma(\pi^+,p)$, $\sigma(K^-,p) > \sigma(K^+,p)$, and $\sigma(\bar{p},p) > \sigma(p,p)$ up to 20 Bev are considered under a hypothesis on generalized isospin independence. This states that the isospin of the Λ particle is zero; all hyperons have strangeness of the same sign; the strangeness of all hyperons is negative; and the π and K mesons have baryon number zero. Other relations may be considered under these conditions. (L.N.N.)

10906 MULTINUCLEON CAPTURE OF K^- MESONS. Janusz Zakrzewski (Univ. of Warsaw). Postępy Fiz., 11: 405-17(1960). (In Polish)

The experimental results and the more recent theoretical models of K^- capture are presented, with emphasis on the multi-nucleon interaction with K^- mesons. K^- capture appears to take place while the meson is in a Bohr orbit with respect to the center of the nucleus, and subsequently interacts with the nucleus after falling to a lower energy state (smaller orbit) with the emission of a gamma-ray. The capture takes place predominantly at the surface of the nucleus. The multi-nucleon interaction, in one of the models, takes place with nucleon clusters, very likely with alpha clusters. The experimental evidence to date, however, indicates that none of the models thus far proposed can be fully accepted in that none fully explain the observations. The many-nucleon interaction in K^- capture becomes more probable with increasing atomic weight of the nucleus, and this will probably be explained only in the course of further investigation. The ratio of mono-nucleon to many-nucleon interaction should be very interesting as investigated with a liquid helium bubble chamber. This would be very important for the investigation of the proposed alpha-model of interaction. A propane bubble chamber would also be of great use in studying capture in carbon with its alpha-structure. The frequency of emission of deuterons, tritons and other particles in K-capture, and their energy and angular distributions should become important contributions to the problem of K^- capture. (TTT)

10907 MEASUREMENTS OF MAGNETIC MOMENTS OF SHORT-LIVED NUCLEAR EXCITED STATES. A. Z. Hrynkiewicz (Inst. of Nuclear Physics, Polish Academy of

Science, Krakow and Jagellonian Univ., Krakow). Postępy Fiz., 11: 521-49(1960). (In Polish)

A review is presented of the many theoretical foundations and the experimental approaches to measuring the magnetic dipole moment of short-lived excited states, along with the theoretical foundations that are employed in obtaining the correct value of μ from the measurements. Among the more successful experimental approaches is the measurement of angular correlation of two cascading gamma rays with and without the Larmor precession induced by an external magnetic field. When the resolving time of the coincidence circuit employed is much longer than the known decay time, three variations of the so-called integral method are employed: (1) the angular distribution is measured first without a magnetic field, next with a magnetic field H_0, and finally with the same magnetic field but of opposite polarity; (2) the anisotropy of the angular distribution is measured as a function of H; and (3) the coincidence rate, at an angle θ between the two cascading particles, is measured with a fixed magnetic field of a given polarity, then with the opposite polarity. Another general method measures the angular correlation or anisotropy as a function of time. The method of angular distribution in Coulomb excitation is also covered. By far the most accurate method reviewed is that employing the Mössbauer effect. Twenty-five measured values of the excited states of fourteen different nuclei are presented, along with corrections made in cases where the half life of the excited state was better known at the time this report was prepared. (TTT)

10908 NINTH INTERNATIONAL ANNUAL CONFERENCE ON HIGH ENERGY PHYSICS, KIEV, 15-25 JULY 1959. PLENARY SESSION I-V. Moscow, International Union of Pure and Applied Physics, 1960. 608p.

Fourteen papers are presented from sessions I through V of the conference. Thirteen of the papers have been abstracted separately; the other paper has been previously abstracted in NSA. (T.F.H.)

10909 PION PHOTOPRODUCTION AND COMPTON EFFECT ON NUCLEONS. G. Bernardini (CERN, Geneva). p.13-82 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

A review is presented of resonance effects in the reactions $\gamma + p \rightarrow p + \pi^0$ and $\gamma + p \rightarrow n + \pi^-$, at γ energies up to 1150 Mev. Pion photoproduction on deuterons is also discussed. The threshold effects involved in these reactions are studied. Compton scattering by protons is examined, at proton energies up to 250 Mev. (T.F.H.)

10910 PION-NUCLEON SCATTERING AND SINGLE PION PRODUCTION IN NUCLEON-NUCLEON AND PION-NUCLEON INTERACTIONS. B. Pontecorvo (Joint Inst. for Nuclear Research, Dubna, USSR). p.83-176 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

Charge independence is found to be valid for processes involving pions and nucleons, especially in the reactions $\pi N \rightarrow \pi N$, $NN \rightarrow NN\pi$, $p + d \rightarrow He^3 + \pi^0$, $p + d \rightarrow H^3 + \pi^+$, $d + d \rightarrow He^4 + \pi^0$, and the π^--p interaction, and in the π^0 and ρ^0 mesons. The characteristics of $\pi N \rightarrow \pi N$ scattering at 0 to 500 Mev, of $NN \rightarrow NN\pi$ reactions from threshold to 1000 Mev, and of $\pi N \rightarrow \pi\pi N$ reactions from threshold to 1000 Mev, are given detailed study from both the experimental and theoretical viewpoints. (T.F.H.)

10911 ANTINUCLEONS AND THEIR INTERACTIONS. E. Segrè (Univ. of California, Berkeley). p.179-210 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

A summary is presented of methods for detecting the interactions of antiprotons, of the physical properties of the $\bar{p}$, and of the $\bar{p}$ cross sections on H, D, C, and emulsion nuclei. The excitation function for the production of $\bar{p}$ by p-C reactions is given. The detection of a $\bar{\Lambda}$ hyperon is reported. (T.F.H.)

10912 NUCLEON-NUCLEON AND PION-NUCLEON INTERACTION. V. I. Veksler (Joint Inst. of Nuclear Research, Dubna, USSR). p.211-68 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

Experimental data and theoretical predictions are compared for proton interactions with protons, neutrons, and pions, at energies of about 1 to 10 Bev. Both elastic and inelastic interactions are considered. (T.F.H.)

10913 NUCLEON NUCLEON SCATTERING. Ya. (Y.) A. Smorodinskii (Smorodinsky) (Joint Inst. for Nuclear Research, Dubna, USSR). p.271-312 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

A review of polarization correlation and scattering matrix studies of p-p and p-n interactions at about 100 to 650 Mev is presented. Theoretical studies involving determinations of the scattering matrices, phase shifts, and nucleon potentials are outlined. (T.F.H.)

10914 THEORY OF STRONG COUPLING OF ORDINARY PARTICLES. Geoffrey F. Chew (Univ. of California, Berkeley). p.313-52 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

Double dispersion representations are applied to the interactions N-N, π-N, and π-π, in order to explain the strong coupling effects observed in these interactions. The related reactions of pion photoproduction on nucleons, and of gamma Compton scattering on nucleons, are also studied in this context. (T.F.H.)

10915 ON NUCLEON STRUCTURE. Robert Hofstadter (CERN, Geneva). p.355-77 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

A review is presented of determinations of neutron and proton charge and magnetic moment form factors. The form factors are determined by electron scattering from protons and deuterons. The form factors are found as functions of q^2, where hq is the 4-momentum-energy transfer of the virtual photon involved in the scattering process. (T.F.H.)

10916 ELECTROMAGNETIC INTERACTION AND NUCLEON STRUCTURE. W. K. H. Panofsky (Stanford Univ., Calif.). p.378-409 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

Proposed experiments to test the validity of quantum electrodynamics at high momentum transfers are reviewed. Low-momentum-transfer experiments are discussed with

respect to their implications in quantum electrodynamics, including: the scattering of positrons by electrons at a momentum transfer of 10 Mev/c; the bremsstrahlung from electrons; and the production of electron-positron pairs in π^0 decay. The use of the elastic reaction e + D → e′ + D in the determination of the neutron form factors is described. (T.F.H.)

10917 NUCLEON STRUCTURE AND ELECTROMAGNETIC INTERACTION THEORY. L. L. Schiff (Stanford Univ., Calif.). p.410-40 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

A study is made of the validity of the single-virtual-photon approximation that is used in calculations of the nucleon form factors. The determination of the form factors by means of elastic electron scattering by polarized protons and deuterons, and by means of pion production by electrons on protons, is discussed. The theory of nucleon form factors is reviewed. The problem of the breakdown of quantum electrodynamics at small distances is considered. (T.F.H.)

10918 STRANGE PARTICLE PRODUCTION. J. Steinberger (Columbia Univ., New York). p.443-70 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

Cross sections, angular distributions, and resonances are described in the reactions $\pi^- + p \rightarrow K^0 + (\Lambda^0 \text{ or } \Sigma^0)$ and $\pi^- + p \rightarrow K^+ + \Sigma^-$, at laboratory π^- momenta of 940 to 1220 Mev/c. The reaction $K^- + p \rightarrow \Xi^- + K^+$, at a K^- momentum of 1.15 Bev/c, is studied. For the decay $\Xi^- \rightarrow \Lambda^0 + \pi^-$ a Q-value of 64.0 ± 0.5 Mev and a lifetime of $1.9 \pm \sim 1 \times 10^{-10}$ sec is found. The angular dependence of K^0 emission from p-nucleus collisions is discussed. (T.F.H.)

10919 EMULSION STUDIES OF THE INTERACTION OF K^- MESONS WITH NUCLEI. (SUPPLEMENTARY REPORT). E. H. S. Burhop. p.534-9 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

Studies of K^- capture at rest in nuclei, and of Λ, Σ^+, and Σ^- hyperon emission processes following the K^- capture, are summarized. (T.F.H.)

10920 STRANGE PARTICLE THEORY. Abdus Salam (Cambridge Univ., Eng.). p.540-86 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

A review is presented of information on K^--p and K-d interactions; on K-meson dispersion relations and parity; and on symmetry properties of strange particles, with particular attention to the doublet approximation. (T.F.H.)

10921 HYPERFRAGMENTS AND HYPERON-NUCLEON INTERACTION. R. H. Dalitz (Univ. of Chicago). p.587-608 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Session I-V." Moscow, International Union of Pure and Applied Physics, 1960.

The binding energies of a number of Λ hyperfragments of H, He, Li, Be, and B, having mass numbers from 3^+ to 12^+, are determined. The Λ-nucleon interaction is studied phenomenologically and within the framework of meson theory. Branching ratios in ${}_{\Lambda}H^3$ and ${}_{\Lambda}H^4$ decays are measured. An event is described that is thought to verify the existence of a Σ^--n bound state. An event is described that is consistent with production of a Ξ^- in a nucleus by a π^--nucleus collision, and subsequent reaction of the Ξ^- ($\Xi^- + n \rightarrow \Lambda + \Lambda$) within the same nucleus. (T.F.H.)

10922 NINTH INTERNATIONAL ANNUAL CONFERENCE ON HIGH ENERGY PHYSICS, KIEV, 15-25 JULY 1959. PLENARY SESSIONS VI-IX. Moscow, International Union of Pure and Applied Physics, 1960. 440p.

Sixteen papers are presented from sessions VI through IX of the conference. Twelve of the papers have been abstracted separately; the other four papers have been previously abstracted in NSA. (T.F.H.)

10923 THEORETICAL INVESTIGATIONS ON DISPERSION RELATIONS. D. V. Shirkov (Joint Inst. for Nuclear Research, Dubna, SSSR). p.3-28 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

Theoretical aspects of ordinary dispersion relations with respect to the energy variables are outlined. Derivations of these relations are presented, based on quantum field theory and perturbation theory. (T.F.H.)

10924 GENERAL PROPERTIES OF TRANSITION AMPLITUDES AND SPECTRAL FUNCTIONS. H. Lehmann (Universität, Hamburg). p.29-53 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

A review is presented of several rigorous derivations and perturbation-theory investigations of scattering matrices, dispersion relations with respect to the momentum transfer variable, and spectral representations. (T.F.H.)

10925 ON ANALYTICAL PROPERTIES OF VERTEX PARTS IN QUANTUM FIELD THEORY. L. D. Landau (Vavilov's Inst. of Physical Problems, Academy of Sciences, Moscow). p.95-101 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

A method is discussed which, in theory, makes possible the determination of all the singular lines of any scattering amplitude. The behavior of the scattering amplitude near these singular lines is also investigated. (T.F.H.)

10926 ON THE FIELD THEORY WITH GREEN FUNCTIONS HAVING SINGULARITIES ON HYPERBOLOID. A. A. Komar (Levedev Inst. of Physics, Moscow) and M. A. Markov. p.102-13 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

Two suggested methods for eliminating indefinite matrices from field theories are discussed. The methods involve transforming singularities, which are encountered in functions of interparticle distances, from the light cone to an hyperboloid whose asymptote is the cone. In one method, the transformation is applied to all such functions. In the other, the transformation is applied only to the Green's function. (T.F.H.)

10927 REMARKS ON THE NEUTRINO GAUGE GROUP. Bruno Toushek (Università degli Studi, Rome). p.117-19 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

A simplified model of Heisenberg's 4-spinor field theory is presented, which is invariant under the transformation $\psi' = \exp(i\gamma_5 a)\psi$ (ψ = neutrino field operator). The degen-

eracy of massive particles, as well as the properties of the Hilbert space associated with the field, are discussed. (T.F.H.)

10928 QUANTUM FIELD THEORY WITH THE "WRONG" CONNECTION BETWEEN SPIN AND STATISTICS. S. D. Drell (Stanford Univ., Calif.). p.137-46 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

The properties of fields in which integer-spin fields are quantized with anti-commutators (fermions), and half-integer-spin fields with commutators (bosons), are studied theoretically. Calculations through fourth order in the coupling lead to an S-matrix that predicts the conservation of statistics in strong interactions. Microscopic causality is not conserved. The relation of these results to the properties of strange particles is discussed. (T.F.H.)

10929 STRONG AND WEAK INTERACTIONS IN A SIMPLE FIELD-THEORETICAL MODEL. L. Van Hove (Rijksuniversiteit, Utrecht). p.147-50 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

An exactly renormalizable, nonlinear extension of the Lee model field is considered, in which the Hamiltonian allows the reactions $N \rightleftharpoons V + \Theta$ and $V \rightleftharpoons N + \Theta$. V and N are considered to be heavy particles. For an infinite cutoff, the model yields strong interactions only, and an exact summetry law. For a large but finite cutoff, the model yields strong and weak interactions, and an approximate symmetry law. (T.F.H.)

10930 WEAK INTERACTIONS. A. I. Alikhanov (Inst. for Theoretical and Experimental Physics, Academy of Sciences, Moscow). p.163-214 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

A review is presented of experimental difficulties encountered in verifying the two-component neutrino theory. The examination of this theory in both beta and muon decays is discussed. The quantitative measurement of time-parity non-conservation in beta decay is investigated. An outline is given of the theory of "weak magnetism" effects. Values of the interaction constants for several weak reactions, such as μ^- capture and decay, are given. The beta and gamma emissions by π and μ mesons are examined. Measurements of the neutrino mass; the polarization of internal conversion electrons; and the scattering, magnetic moment, mass, E1 moment, polarization and depolarization, and transitions in mesic atoms of muons are summarized. (T.F.H.)

10931 STRANGE PARTICLE DECAYS. D. A. Glaser (Univ. of Michigan, Ann Arbor). p.242-68 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

Lifetimes of the K^0, Λ^0, Σ^+, and Σ^- are discussed. Branching ratios of K^0 and Λ^0, and Σ^+ and Σ^- decay asymmetries, are found to be consistent with $\Delta I = \frac{1}{2}$. The Λ, Σ^+, and Σ^- are found to have spin $\frac{1}{2}$. Leptonic decay modes of Λ, Σ^+, and Σ^- are found to comprise <0.5% of all decays, and to be ten times less common than the Universal Fermi Interaction predicts. Mesons K^0 and $\bar{K}^0$ are found to be heavier than K^+ and K^-, respectively. Proof is found for the existence of the Ξ^0 hyperon. (T.F.H.)

10932 THEORETICAL STATUS OF WEAK INTERACTIONS. R. E. Marshak (Univ. of Rochester, N. Y.). p.269-317 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

The status of the V−A theory of weak interactions is summarized, for four major types of 4-fermion interactions: processes involving only leptons (e.g., muon decay); strangeness-conserving processes involving leptons and baryons or mesons (e.g., nuclear beta decay, pion decay, and nuclear absorption of muons); strangeness-nonconserving processes involving leptons and baryons or mesons (e.g., $K_{\mu 2}$, $K_{\mu 3}$, K_{e3}, and the lepton decay of hyperons); and non-leptonic processes (e.g., $K_{\pi 2}$, $K_{\pi 3}$, and the non-leptonic decay of hyperons). (T.F.H.)

10933 NUCLEAR PROCESSES AT SUPER-HIGH ENERGIES. C. F. Powell (Bristol Univ., Eng.). p.321-57 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

Observations of nuclear interactions of cosmic particles having energies near the order of 10^{15} ev are reviewed. Measurements at ground level and at altitudes up to 120,000 ft are discussed. Measurements are reported of the energies of nucleon-nucleon collisions; of the inelasticity of the collisions; of the natures, transverse momenta, energies, and angular distributions of the secondary particles; the numbers of secondary mesons; and of jets from nucleon-nucleus interactions. (T.F.H.)

10934 MULTIPLE PRODUCTION AT SUPER-HIGH ENERGIES. E. L. Feinberg (Lebedev Inst. of Physics, Moscow). p.358-407 of "Ninth International Annual Conference on High Energy Physics, Kiev, 15-25 July 1959. Plenary Sessions VI-IX." Moscow, International Union of Pure and Applied Physics, 1960.

The hydrodynamical theory for multiple particle production in high-energy collisions is reviewed. The effects of both head-on and peripheral collisions are considered, and the quantum-field theoretical implications of the collision theory are outlined. Some quantitative predictions of the hydrodynamical theory are summarized. The problem of stars having two maxima in the distribution of their $-\ln(\tan \Theta)$ values is discussed. The problems of non-locality (i.e., of the existence of a "fundamental length") and of weak interactions are also considered. (T.F.H.)

Neutron Physics

10935 (AE-63) NUMERICAL INTEGRATION OF THE TRANSPORT EQUATION FOR INFINITE HOMOGENEOUS MEDIA. Rune Håkansson (Aktiebolaget Atomenergi, Stockholm). 1962. 16p.

The transport equation for neutrons in infinite homogeneous media is solved by direct numerical integration. Accounts are taken to the anisotropy and the inelastic scattering. The integration is performed by means of the trapezoidal rule and the length of the energy intervals are constant in letargy scale. Results are given for water, heavy water, aluminium–water mixture and iron–aluminium–water mixture. (auth)

10936 (DC 58-9-198) MULTI-ENERGY NEUTRON DIFFUSION ADJOINT (DIGITAL COMPUTER PROGRAM G*). D. R. Speece (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 26, 1958. Contract AT(11-1)-171. 23p.

The multi-energy neutron diffusion adjoint was constructed with sufficient generality to include all slowing-down models linearly relating slowing-down density and flux, such as Selengut modified-age, Wigner first-moment, and Greuling-Goertzel second-moment. The corresponding first-order perturbation theory was formulated for application to aircraft nuclear reactor design work. (auth)

10937 (DC-60-2-79) RELAXATION LENGTH OF FAST NEUTRON DOSE RATE IN HYDROGENOUS MATERIAL AS GIVEN BY ALBERT WELTON TYPE POINT KERNELS. F. Johnson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 8, 1960. Contract AT(11-1)-171. 13p.

A general analytic expression for the relation length (λ) of fast neutron dose rate or flux is derived from the Albert-Welton type point fission kernel. The application of the expression for λ and additional characteristics which can be derived from it are described. As an example of application, a graph is plotted of λ as a function of distance from a point fission source in water as given by the derived expression using two different sets of α constants. The use and form of the Albert-Welton type kernel are briefly described and some of the established sets of α constants are listed. (auth)

10938 (NARF-61-43T) ANGULAR SEGMENTATION METHOD. N. Edmonson and L. M. Bostick (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Feb. 28, 1962. Contract AF33(657)7201. 105p. (FZK-9-172)

The angular segmentation method for calculating numerical approximations to solutions of the Boltzmann transport equation is developed for a spherically symmetric shield system. Anisotropic elastic scattering is assumed. Energy-group transfer coefficients are developed by using the Dirac δ-function. A general matrix formulation for the anisotropic case is constructed. These procedures are applied to the computation of angular neutron distributions and total neutron distributions. (auth)

10939 (ORNL-3229) ISOPERIMETRIC AND OTHER INEQUALITIES IN THE THEORY OF NEUTRON TRANSPORT, II. Lawrence Dresner (Oak Ridge National Lab., Tenn.). Feb. 27, 1962. Contract W-7405-Eng-26. 41p.

In a previous paper, some inequalities occurring in the one-velocity theory of neutron transport with isotropic scattering were derived. Some of the previous results are generalized to the case of linearly anisotropic scattering. (auth)

10940 (WAPD-T-1065) SPACE-ENERGY SEPARABILITY IN THE THERMAL NEUTRON GROUP. E. Gelbard, J. Davis, and J. Pearson (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1959. Contract AT-11-1-GEN-14. 14p.

Presented at the 1959 Winter Meeting of the American Nuclear Society, Washington, D. C.

Spatially dependent thermal neutron problems were analyzed based on assumptions of separability. A study was made of the range of validity of these assumptions for water moderators. The problems discussed are computation of thermal diffusion lengths and the decay period of pulsed moderators with given buckling. (M.C.G.)

10941 DETERMINATION OF THE ADJUNCT FLUX OF THERMAL NEUTRONS BY PERTURBATION EXPERIENCES. M. Sabău and T. Roşescu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercĕtari fiz., 12: 583-7(1961). (In Rumanian)

A method is shown permitting the determination of the adjunct flux of thermal neutrons. Moreover, they give the values calculated for the thermal flux and its adjunct by the two-group model of neutrons in the diffusion theory. The product of these fluxes was determined experimentally by a perturbation method. (tr-auth)

10942 INSTALLATION FOR THE MEASUREMENT OF THE DIFFUSION LENGTH OF NEUTRONS IN LIQUIDS. N. Mateescu and N. Duţescu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercĕtari fiz., 12: 661-6(1961). (In Rumanian)

The installation for the measurement of the variation of the diffusion length of thermal neutrons in liquid moderators as a function of the temperature is described. It can be operated both in the thermal column of a reactor and with a neutron source. A preliminary measurement of a diffusion length was made by utilizing a Po–Be neutron source and distilled water as moderator. (tr-auth)

10943 ON THE SLOWING DOWN OF NEUTRONS IN AN ABSORPTIVE MEDIUM. I. A. Kozachok (Inst. of Geophysics, L'vov Branch of the Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 9, 1156-60(1961). (In Ukrainian)

The slowing down and resonance capture of neutrons in a homogeneous medium is considered. The problem can be reduced to a simple non-capture case when (Ψ_p) the neutron space energy distribution in the resonance interval is known. Ψ_p is easily determined for the case of narrow resonances and absorption by heavy nuclei. Hence, the problem is solved by means of the spherical harmonic method. (auth)

10944 SCATTERING OF SLOW NEUTRONS FROM PROPANE GAS. K. A. Strong, G. D. Marshall, R. M. Brugger, and P. D. Randolph (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 125: 933-7(Feb. 1, 1962).

Measurements of the partial differential neutron scattering cross sections for room-temperature propane gas are reported. These measurements were made at incident energies of 0.0101, 0.0254, 0.0736, and 0.102 ev at seven scattering angles between 16.3 and 84.7° using the Materials Testing Reactor phased chopper velocity selector. The data are converted to the scattering-law presentation and compared with three theoretical calculations: The ideal gas, using an effective mass obtained from an average of the mass tensors for the three types of H atoms in propane, gives poor agreement. The Krieger-Nelkin approximation, which includes the effect of zero-point vibrations, gives limited agreement for energy transfer less than 0.5 k_BT at intermediate momentum transfers. At large momentum transfers where vibrational effects become important it underestimates the cross section. A modification of the Krieger-Nelkin theory that includes the effects of single-quantum transitions from the three lowest vibrational states gives better agreement. The discrepancies still present at large momentum and energy transfers are attributed to an uncertainty in the methyl-group barrier height for the three lowest energy modes, to the harmonic oscillator approximation for these modes, and to the approximate molecular orientation averaging used in the calculation. (auth)

Nuclear Properties and Reactions

Refer also to abstracts 9761, 10206, and 10249

10945 (AD-260039) MEAN LIFE OF THE NEGATIVE MUON IN CARBON (thesis). Robert Albert Butterfield (Utah. Univ., Salt Lake City). June 1961. 34p.

Positive and negative muons are stopped and their decay observed. The composite mean life of these muons is calculated and the negative mean life in carbon is computed from the composite data. Results of calculations show a composite mean life in carbon of $(2.087 \pm 0.037) \times 10^{-6}$ sec, and the negative muon mean life in carbon is $(1.94 \pm 0.09) \times 10^{-6}$ sec. (J.R.D.)

10946 (APEX-704) REACTOR NEUTRON CROSS SECTIONS IN FINE ENERGY DETAIL. J. R. Cooper, R. E. Sullivan, and W. B. Henderson (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 27, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 158p.

References to the data and a brief résumé of the methods used in generating cross sections stored on magnetic tapes in fine energy detail are given. The data are used directly in bare, homogeneous reactor slowing-down calculations or can be processed to provide multi-group or multi-level cross sections in coarser energy detail for other machine programs. Cross sections for 33 elements or isotopes, the U^{235} prompt and total fission spectra, and the Be(n,2n) transfer cross sections are currently available. (auth)

10947 (AROD-2810.4) PHOTON ABSORPTION BY VALENCE ELECTRONS IN Mg, Cr, Fe, and Co. Technical Report No. 4. H. Kroger (Cornell Univ., Ithaca, N. Y.). Feb. 1962. 103p.

A report of experimental studies concerning the absorption of soft x-ray–vacuum ultraviolet radiations by metals is presented. Since the energies of the incident photons are just insufficient to excite x-ray levels of the atoms, the most important mechanism for the removal of energy from the photon beam is interband excitation of valence electrons. The absorption of light in this frequency range should therefore yield some information about the electronic valence and conduction states of metals. The absorption spectrum of Mg was determined over a spectral range which was not previously investigated. It is possible to account for the main features of the extreme ultraviolet absorption spectrum of Mg with a theory of interband excitations of the valence electrons. In discussing this process it was useful to represent the electronic structure of the valence band of magnesium by a nearly free electron approximation. Only one of the optical constants (the extinction coefficient, K) was measured and therefore neither the dielectric constant nor the conductivity was determined. The usefulness of the experiment as a guide to the interpretation of electron energy loss spectra is severely limited. In particular, it was found difficult to unambiguously identify the "onset of transmission" at the plasma frequency of the transition elements. (auth)

10948 (DC-57-1-75) FISSION NEUTRON SPECTRUM FOR U^{235}. F. Silverstein (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 19, 1956. Contract AT(11-1)-171. 8p.

Methods of incrementally averaging experimental data on fission neutron spectra for digital computer use are described, and the multi-group prompt fission neutron spectrum and prompt-plus-delayed fission neutron spectrum are given for U^{235}. (auth)

10949 (DC 57-2-129) THERMAL NEUTRON INDUCED BETA AND GAMMA RADIOACTIVITY FOR CERTAIN ISOTOPES, ELEMENTS AND MATERIALS. T. J. Kostigen (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 22, 1957. Contract AT(11-1)-171. 261p.

To facilitate the rapid computation of radiation dosages from various materials exposed to neutron irradiation, graphs and pertinent nuclear information were assembled for general engineering use. (auth)

10950 (DC 59-4-199) URANIUM-235 FISSION PRODUCT ACTIVITY AND ENERGY AS A FUNCTION OF DECAY TIME FOR A SPECIFIC IRRADIATION TIME AND THERMAL FLUX. C. B. Magee (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 21, 1959. Contract AT(11-1)-171. 28p.

The activity and beta minus power of the individual radioactive fission products are given as a function of cooling time up to about 30 hours for an irradiation time and thermal neutron flux that approximate conditions in a one week irradiation in the LITR. The recent compilation of Blomeke and Todd was used for the most part, to obtain concentrations of individual nuclides. Totals of activity and β^- power were obtained from the values for the individual fission products, and these totals are compared in graphical form to similar totals given by Blomeke and Todd. Comparison is made also to totals of total power and γ power given by Blomeke and Todd and to a modified Way-Wigner expression which is reported to represent either the γ^- or β^- power within a factor of two for cooling times from 10 seconds to 100 days. For cooling times beyond 30 hours the total quantities of Blomeke and Todd are compared to the same Way-Wigner expression. Some conclusion based on these comparisons are given. (auth)

10951 (DC-59-12-221) PULSED NEUTRON MEASUREMENTS ON BERYLLIUM OXIDE. K. W. Seemann (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 30, 1959. Contract AT(11-1)-171. 15p.

The diffusion parameters of some beryllium oxide slabs were measured by the pulsed neutron technique using the ANPD 11.6-Mev betatron at Evendale with the results: $v\Sigma_a = 655$ sec^{-1} and $vD = 1.17 \times 10^5$ cm^2/sec. Thus the macroscopic absorption cross section of the beryllium oxide for 2200 m/sec neutrons is: $\Sigma_a = (3.0 \pm 0.2) \times 10^{-3}$ cm^{-1}; the diffusion constant: $D = 0.46 \pm 0.03$ cm. (auth)

10952 (DC-60-1-168) EVALUATION OF THE DETECTOR ANGULAR DISTRIBUTION OF AIR-SCATTERED GAMMA RAYS COMPUTED BY WRIGHT AIR DEVELOPMENT CENTER'S MONTE CARLO CODE (MILESTONE 1, TASK 431311, JOB 53284). M. A. Capo (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 22, 1960. Contract AT(11-1)-171. 25p.

Tabulated in ORNL 2292 are the energy and angular distribution of air-scattered gamma rays obtained using a Monte Carlo method of computation. An evaluation of those angular distributions is presented. Results indicate that further reduction and utilization of these data would not be beneficial to ANPD. A proposal is presented of compiling more useful data. (auth)

10953 (DC-60-5-727) THE RELATION BETWEEN CATCHER FOIL ACTIVITY AND FISSION RATE IN 93% ENRICHED URANIUM METAL. J. F. Kunze and J. W. Churchill (General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho). May 13, 1960. Contract AT(11-1)-171. 26p.

The use of Al fission product catcher foils to power map and calibrate reactors requires that the activity accumulated on the catcher foil be correlated with the actual fission rate in the U. Au foils, 5 mils thick, and 93% enriched U foils, of the same diameter and 1 mil thick with catcher foils attached, were given 20 minute exposures in the neutron flux in the water outside the reflector of the D101 critical experiment tank. The foils were counted in the TMC beta counting system at LPT. The Au foil counting efficiency was obtained from gamma ray spectrometer meas-

urements of the absolute disintegration rate of Au^{198}. The flux determined from the Au foil counts was used to compute the flux and the average fission rate in the 1 mil U foil. The conversion number obtained was 62.7 ± 3.8 (fissions per second per gram of U^{235}) per (count per minute) from a 9/16 inch diameter catcher foil counted in the TMC counters 50 minutes after shutdown following a 20 minute exposure. The corresponding number for the PC_3 counter system is 57.3. The expected error is ±6%. These values agree satisfactorily with existing correlations to thermodynamic power measurements. (auth)

10954 (EFINS-61-68) THE PENETRATION OF MATTER BY HEAVY IONS OF KINETIC ENERGIES BELOW 1 MEV PER ATOMIC WEIGHT UNIT. S. K. Allison and M. Garcia-Munoz (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). Nov. 1961. Contract [AT(11-1)-104]. 34p.

Data on experimental stopping power and range determination of heavy ions in solids and gases are summarized. The stopping power of various gases and metals were determined for He, C, N, and O ions. The ranges of the following ions in solids and gases were also determined: He, Li, C, N, O, Ne, Ar, Kr, Xe, Cu, Ag, Au, and alkali metal. Data are also included on atoms recoiling from alpha emission. (M.C.G.)

10955 (INSJ-47) LIQUID HYDROGEN TARGET FOR THE MEASUREMENT OF SPIN CORRELATION COEFFICIENTS IN PROTON-PROTON SCATTERING AT 50 MEV. S. Kobayashi, K. Nisimura, J. Sanada, D. C. Worth, H. Imada, N. Ryu, H. Hasai, K. Fukunaga, Sung Baik Nung, and Y. Hiradate (Tokyo Univ. Inst. for Nuclear Study). Jan. 22, 1962. 7p.

Design and operation of a liquid H target are described for use in measuring spin correlation coefficients in proton-proton scattering at 50 Mev. (J.R.D.)

10956 (JINR-D-694) ON THE DEGREES OF GROWTH OF MATRIX ELEMENTS IN THE AXIOMATIC METHOD. B. V. Medveded and M. K. Polivanov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 19p.

A discussion is presented on the extent to which matrix element's degrees of growth can be arbitrarily prescribed. It is concluded that the degree of arbitrariness is very small, and for the most important class of the properly renormalizable theories, the degrees of growth need not be set up by special postulate, but are uniquely determined by the system of fundamental principles set up by Bogolubor and others, and the transformation properties of fields. The investigation concerns the most simple case of spinless self-interacting field which may be performed without explicit use of the perturbation theory. (J.R.D.)

10957 (JINR-P-826) TONKAYA STRUKTURA ENERGETICHESKOGO SPEKTRA KOLLEKTIVNYKH KOLEBANII CHETNO-CHETNYKH YADER. (Fine Structure of Energy Spectra for Collective Oscillations of Even-Even Nuclei). Liang-yüan Ch'a (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 7p.

The energy spectra for collective oscillations of even-even nuclei are analyzed, and corrections are made which partially eliminate the degeneration found by Bohr (Dan. Mat.-Fyz. Medd. No. 14, 1952) in the collective nuclear model at high excitation levels. Theoretical energy levels of Xe^{134} and Xe^{132} are correlated with experimental data, and the results are in good agreement. (R.V.J.)

10958 (NEVIS-99) ASYMMETRY MEASUREMENTS OF POSITIVE MUON DECAY IN GASES AND A STATIC FIELD INVESTIGATION OF THE MUONIUM GROUND STATE HYPERFINE SPLITTING (thesis). Richard Prepost (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.). Nov. 1961. Contract Nonr-266(72). 72p.

Using counter techniques, the asymmetry in the angular distribution of the decay of positive muons was measured for cyclotron-produced polarized muons stopped in gas samples of O_2, N_2O, Ar, SF_6, and N_2. The asymmetry parameter a in the decay distribution $(1-a\cos\theta)$ is obtained relative to the asymmetry parameter for positive muons decaying in graphite, which yields the maximum possible asymmetry. The results are O_2: $a/a_{graphite} = 0.44 \pm 0.21$; N_2O: $a/a_{graphite} = 0.10 \pm 0.20$; purified Ar: $a/a_{graphite} = 0.22 \pm 0.20$; SF_6: $a/a_{graphite} = 0.75 \pm 0.21$; N_2: $a/a_{graphite} = 0.13 \pm 0.22$; Ar: $a/a_{graphite} = 0.08 \pm 0.15$. Evidence is presented for formation of the muonium (μ^+e^-) atom in pure argon gas by observation of the Larmor precession of the muonium magnetic moment, which also establishes directly that the muon spin is 1/2. The ground state hyperfine splitting $\Delta\nu$ of this atom is measured by a static field technique in which the muon polarization at decay is measured as a function of applied longitudinal magnetic field. The result obtained is $\Delta\nu = 5500$ Mc/sec in agreement with the theoretical value for $\Delta\nu$. (auth)

10959 (NP-11355) PHOTONUCLEAR PHYSICS LECTURES. Technical Report 221. Michael Danos (Maryland. Univ., College Park). July 1961. 146p.

Lectures on elements of photonuclear physics are presented in which the absorption or emission of a single photon is considered. The interaction is treated in the lowest order only and renormalization is not considered. The information is grouped in sections on elements of electrodynamics and photonuclear physics. (J.R.D.)

10960 (TID-14865) FAST NEUTRON DOSIMETRY OF A PLUTONIUM-BERYLLIUM SOURCE (thesis). Donald Conrad Lawrence (Washington. Univ., Seattle). 1958. 120p.

Investigations showed that using a combination of two chambers, one composed of polythylene–ethylene and the other of teflon–CO_2, the doses delivered to a "standard tissue" by the fast neutrons and the gamma rays from a Pu–Be neutron source can be measured. The ionization currents were read on a vibrating reed electrometer. The probable errors in the measurements were about 6% in the neutron dose rate and about 15% in the gamma dose rate. The final results obtained for a 0.980 c Pu–Be source were: fast neutron dose rate at 10 cm = 17.9 ± mrep/hr and gamma dose rate at 10 cm = 1.9 ± 0.4 mrep/hr. From this the source strength was determined to be $1.6 \times 10^6 \pm 0.1$ n/sec. During the experiments it was found that the variation of the conductivity of polyethylene on exposure to radiation can be used as a means of radiation measurement. The theory, apparatus, experimental method, and results are discussed. (M.C.G.)

10961 (TID-14868) MEASUREMENT OF THE THERMAL NEUTRON CROSS SECTIONS OF GOLD, SILVER, INDIUM, NICKEL, AND NICKEL OXIDE USING A CRYSTAL SPECTROMETER (thesis). Ralph Gordan Allen (Oak Ridge National Lab., Tenn.). June 1953. 134p.

Submitted to Univ. of Texas, Austin.

The range of a crystal spectrometer was extended for the measurement of thermal neutron cross sections. Using transmission methods, total cross section measurements were made for Au, Ag, In, Ni, and NiO over the wavelength region from 1 to 4A. From the data obtained for Au, Ag, and In, total scattering cross sections and thermal capture cross sections were obtained. From the Ni and NiO meas-

urements, it was possible to obtain the Ni and O nuclear coherent scattering cross sections, the incoherent scattering cross section for nickel, and the Debye characteristic temperatures of Ni and NiO. Elimination of higher orders with mirrors, apparatus and performance, crystalline scattering of slow neutrons, and transmission measurements are discussed. (M.C.G.)

10962 (TID-14869) RANGE OF ALPHA PARTICLES IN ALUMINUM (thesis). Donald Gillmor Willhoit (Washington. Univ., Seattle). 1958. 24p.

Studies were carried out to develop a range-energy table for alpha particles in aluminum. An attempt was made to find a suitable empirical L-shell correction for the stopping power of protons from accurate measurements and to extrapolate this correction to alpha particles for the computation of alpha ranges. The theory of particle energy losses in matter, the density effect, and multiple scattering are discussed. The stopping power correction was found to be dependent only on the particles veolcity. Ranges were calculated for alpha particles from 4 to 50 Mev. (M.C.G.)

10963 (TID-14880) INVESTIGATION OF THE DECAY OF Tl-210 (RaC″). Final Report on Research Contract 72/US. Georg Stetter (Vienna. Universität. Physikalisches Institut). [1961]. Contract AT(30-1)-2637. 72p.

The decay scheme of Tl^{210} was investigated. Preparation of sources, decay energy, beta spectra, and gamma spectra are described. A search was made for alpha decay of Tl^{210}, for a long-lived isomeric state in Pb^{210}, and for neutron emission from Tl^{210}. Coincidence measurements are described. The decay scheme is outlined and compared with theoretical expectations. Shell model calculations are presented. (M.C.G.)

10964 (UCRL-5701) THEORIES FOR ANGULAR DISTRIBUTIONS IN LOW ENERGY NUCLEAR REACTIONS. Steven A. Moszkowski (California. Univ., Los Angeles). J. Benveniste and E. H. Schwarcz, eds. (California. Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 98p.

A series of six lectures presented at the Lawrence Radiation Laboratory, Livermore, 1958.

A series of six lectures presented at the Lawrence Radiation Laboratory on angular distributions in nuclear reactions are given. Topics covered include a survey of reaction mechanisms, Born approximation for direct interaction theory, semiclassical approximation for direct interaction, distorted wave analysis and direct surface interactions, the general theory of angular correlation, and interpretation of inelastic proton scattering by means of angular correlation theory. (M.C.G.)

10965 (FTD-TT-61-175) NEWS OF THE ACADEMY OF SCIENCES OF THE USSR, PHYSICS SERIES (SELECTED ARTICLES). Translation of Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 61-7; 124-9; 143-4(1961). 28p.

Three papers are included which respectively treat internal conversion with pair production in Ta^{182} decay, masses and binding energies of heavy nuclei, and excited states of U^{235} fission fragments. All three papers were previously abstracted in NSA. (D.L.C.)

10966 (FTD-TT-61-175(p.1-14)) INTERNAL CONVERSION WITH PAIR PRODUCTION DURING THE DECAY OF Ta^{182}. S. S. Vasilenko, M. G. Kaganskii (Kaganskiy), D. L. Kaminskii (Kaminskiy), and S. F. Koksharova. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 61-7(1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 28506.

10967 (FTD-TT-61-175(p.15-24)) MASSES OF HEAVY ATOMS AND BINDING ENERGIES OF NUCLEI IN THE $174 \leq M \leq 239$ RANGE. R. A. Demirkhanov, T. I. Gutkin, and V. V. Dorokhov. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 124-9(1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 28516.

10968 (FTD-TT-61-175(p.25-8)) DETERMINATION OF THE MEAN LIFETIME OF THE EXCITED STATES OF U^{235} FISSION FRAGMENTS. B. M. Shiryaev (Shiryayev). Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 143-4(1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 28519.

10969 (NSF-62-35(1)) RADIATION WIDTHS OF NUCLEI AND STATISTICAL THEORY. A translation of "Radiatsionnye Shiriny i Statisticheskaya Teoriya." Yu. V. Adamchuk and V. M. Strutinskii (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). 1960. 45p.

Within the framework of statistical theory, which accounts for nucleon pairing, the level density and magnitude of radiation widths of nuclei were examined in the presence of neutron binding energy. The temperatures, entropies, and level densities of one-nucleon states of nuclei were calculated. (auth)

10970 LEVELS OF Sn^{115} EXCITED BY THE (p,n) REACTION ON In^{115}. N. Martalogu, E. Ivanov, D. Plostinaru, and N. Vilcov (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 371-7(1961). (In Rumanian)

By bombarding In^{115} with 5.5 to 6.5 Mev protons, two peaks (497 and 113 kev) were obtained. These were interpreted as transitions in Sn^{115}. A scheme is proposed for the first excited levels of Sn^{115}. (tr-auth)

10971 DISINTEGRATION OF DEUTERONS BY NUCLEAR COLLISIONS. M. Micu (Inst. of Atomic Physics, Bucharest). Acad. rep. Populare Romîne, Inst. fiz., atomică şi Inst. Fiz., Studii cercetări fiz., 12: 529-34 (1961). (In Rumanian)

From the Lippmann and Schwinger formalism, the cross section for the decay of the deuteron in the case of its collision with a nucleus is calculated. The formula obtained for the cross section permits an immediate transition to the approximation given by the optical model. In this approximation, the values of the cross section for the formation of the compound nucleus are indicated in the extreme cases of a weak or strong interaction. (tr-auth)

10972 ON THE ANGULAR AND MULTIPLICITY DISTRIBUTION OF SECONDARIES FROM 9-Bev PROTON COLLISIONS WITH LIGHT NUCLEI. E. Friedlaender, M. Marcu, and M. Spirchez (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 535-41(1961). (In Rumanian)

The dependence of the angular and multiplicity distribution of shower particles from 721 stars induced by 9-Bev protons in light emulsion nuclei on the degree of excitation of the residual nucleus was investigated. Within errors the parameters of both distributions were found independent of the number of heavy prongs accompanying the meson shower. This result is inconsistent with a cascade mechanism of meson production. The distribution of η values suggests that at least a fraction of the observed stars is strongly anisotropic in the c.m.s. (auth)

10973 SPECTROPHOTOMETRIC DETERMINATION OF THE RADIOACTIVE PERIOD OF $_{30}Zn^{65}$. V. Tatu (Inst.

of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. Fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: 653-9(1961). (In Rumanian)

The spectrophotometric method used to determine the decay period of Zn^{65} is described. The variation as a function of time of the intensity of the spectral rays of Zn^{65} with respect to the intensities of the spectral rays of Cu^{65}, the end product of Zn^{65} decay, was measured. The value $T_{½} = 249.7 \pm 1.4$ days was obtained for the decay period, which agrees well with the results given by methods specific to nuclear physics. (tr-auth)

10974 CLASSICAL MODELS OF RADIATIVE DECAY. Charles Kaufman and Rolf G. Winter (Pennsylvania State Univ., University Park). Am. J. Phys., 30: 93-7(Feb. 1962).

Classical models for radiative fundamental particle decay are examined. Calculations are presented for radiative nuclear beta processes, pion decay, and muon decay. Features of the photon spectra are obtained correctly for these examples. (auth)

10975 SCATTERING OF 29-Mev He^3 PARTICLES BY FLUORINE. J. Catalá, J. Aguilar, A. García, G. Gil, and J. de la Rubia (Facultad de Ciencias, Valencia). Anales real soc. espãn. fís. y quím. (Madrid), Ser. A, 57: 201-8 (July-Aug. 1961). (In Spanish)

The differential cross sections for the elastic scattering of 29-Mev He^3 particles by F^{19} has been measured using a photographic technique. The angular distribution of He^3 particles elastically scattered has been compared with Rutherford scattering, and a value of 6.01 ± 0.27 fermis is obtained for the interaction radius, using the Fraunhofer diffraction formula for a strongly absorbing disk. By means of a vacuum exposure, a study was carried out for background tracks in the plates, coming from the scattering gap and collimating stops. (auth)

10976 INTEGRAL EQUATION FOR STATIC NUCLEAR POTENTIAL. William M. Frank (U. S. Naval Ordnance Lab., Silver Spring, Md.) and Arnold Tubis. Ann. Phys. (N. Y.), 17: 240-58(Feb. 1962).

The Chew-Low formalism is applied to the solution of an integral equation for the potential between two fixed nucleons. A unique solution in the form of an expansion in the number of exchanged mesons is found and the contribution of one and two meson exchanges is evaluated. The potential agrees with results of other calculations. (auth)

10977 TEMPERATURE-DEPENDENT GREEN FUNCTIONS AND NEUTRON SCATTERING IN LIQUID HELIUM II. W. E. Parry and R. E. Turner (Clarendon Lab., Oxford). Ann. Phys. (N. Y.), 17: 301-17(Feb. 1962).

The partial scattering cross section of slow neutrons from liquid helium II is calculated using temperature-dependent Green functions. The theory of these functions is reviewed. An expression is obtained for the scattering cross section as a function of momentum lost by the neutron and the temperature. Line widths of the scattered neutrons are considered. Results are discussed and compared with experiment, where possible. (auth)

10978 STUDY OF THE $Li^6(t,n)$, $Li^7(t,n)$, $Li^7(He^3,n)$, $Be^9(t,n)B^{11}$ AND $Be^9(He^3,n)C^{11}$ REACTIONS. V. I. Serov and B. Ya. Guzhovskii. Atomnaya Energ., 12: 5-11(Jan. 1962). (In Russian)

Reactions involving tritons and He^3 ions are of special interest because the properties of nuclei at high excitation energies may be studied at a relatively low kinetic energy of the bombarding particles. For this reason neutron spectra obtained upon bombarding thin targets containing Li^6, Li^7, and Be^9 were investigated at energies ranging from 140 kev to 1.4 Mev in a horizontal electrostatic generator. Gas containing 2 to 8% tritium and 92 to 98% He was used in the high-frequency ion source. The neutron yield of the $Li^6(t,n)$ and $Be^9(t,n)$ reactions was found to be proportional to the penetrability of the Coulomb barrier. At low energies of the accelerated particles resonances corresponding to the reaction threshold values of the constituent nuclei were observed in the $Li^7(t,n)$ and $Li^7(He^3,n)$ reactions. In studying the thresholds of formation of slow neutrons by interaction of these nuclei with tritons, slow neutrons corresponding to the Be^8 nucleus at 16.08, 16.66, and 16.94 Mev and to the Be^9 nucleus greatly below the 10.50-Mev level were observed. The neutron spectra determined under and angle of 0^0 by means of nuclear emulsions agreed well with the values of Be^8, Be^9, B^9, B^{11}, and C^{11} reported by F. Ajzenberg-Selove and T. Lauritsen (Nuclear Physics 11, 1: 1(1959)). (TTT)

10979 MEASUREMENT OF THE ACTIVITY OF SHORT-LIVED GASES IN MIXTURES OF FISSION PRODUCTS. V. A. Bryzgunov. Atomnaya Energ., 12: 40-7(Jan. 1962). (In Russian)

It is often convenient to determine the radioactivity of gases by means of their decay products, especially in the case of short-lived rare gas mixtures. The electrical charge which is conserved in the daughter products, is used for collecting the samples. The isotopic mixture may be determined by mass spectrographic, chemical or radiochemical methods. The gases from a reactor loop with direct air flow were collected in a chamber provided with special filters; the filters with the selectively retained gaseous daughter products were counted by the usual methods. Amounts of 10^{-5} g of the individual rare gases were thus separated from the fission product mixture of fuel elements. This preliminary separation step greatly simplified the measurements and increased the sensitivity because the short-lived isotopes could be used. (TTT)

10980 ELASTIC SCATTERING OF NEUTRONS ON TITANIUM AND CALCIUM NUCLEI. G. N. Lovchikova. Atomnaya Energ., 12: 48-9(Jan. 1962). (In Russian)

A method previously described (Atomnaya Energiya 2: 174(1957) No. 2) was used for studying the elastic scattering of neutrons on Ca and Ti, employing the $T(p,n)He^3$ reaction as the neutron source; the protons with the desired charge were obtained by means of a Van de Graaff generator. Neutrons with an average energy of 900 ± 40 kev impinged on the scatterer. A spheric ionization chamber filled with a mixture of H + Ar was used as neutron detector. The angle of scattering was changed by changing the location of the detector in the horizontal plane. The energy and the angular sensitivity of the detector were determined experimentally. Differential cross section curves were determined as a function of the cosine of the scattering angle at angles lying between 30 and 150°; the maximum error was found to be 13%. The cross section values obtained represent elastic scattering cross sections because the first levels of Ti and Ca lie above the energy range studied. The total neutron scattering cross section values, the average cosines of the scattering angles and the elastic transport cross sections were obtained by integration. As no inelastic scattering takes place and the capture cross section has a low value of the order of about 10 millibarn, the total elastic cross section values represent the total cross sections of the two elements. (TTT)

10981 SCATTERING OF NEUTRONS BY MOLECULES. G. K. Ivanov. Atomnaya Energ., 12: 49-51(Jan. 1962). (In Russian)

Selection and precision of the scattering functions play an important role in the thermalization of neutrons. A monatomic approximation was studied involving the replacement of the molecule by a hypothetical free particle the mass of which depends on the rotational property of the molecule but not the orientation with respect to the scattered neutron. The effect of a rigid molecular bond could thus be investigated within the framework of classical mechanics. Comparison of energy moments indicates that in spite of the general scattering effect, the monatomic approximation over estimates the inhibiting effects of the rotator by about 10%. In the thermal energy region the classical model of the solid rotator reflects the real properties of the molecule. The assumption of a rigid molecular bond means that transition under bond excitation (vibrational transitions) are completely excluded. (TTT)

10982 THE SHAPES OF β-SPECTRA AT VARIOUS DEPTHS IN AN IRRADIATED MEDIUM. K. K. Aglintsev and V. P. Kasatkin. Atomnaya Energ., 12: 51-2(Jan. 1962). (In Russian)

It has been previously found for cases involving isotopes with β-radiation only, the dose D_1 on a surface of 1 cm^2 is practically independent of depth in the irradiated medium, the dimensions of the source, and the atomic number of its support, although the average and limiting energy of the spectrum decreases with increasing depth. This empirical rule was further examined by studying the changes in the shape of the β-spectrum while going deeper and deeper into the medium. The isotopes S^{35} with an E_{max} = 0.167 Mev and W^{185} with E_{max} = 0.43 Mev were used for the study. It was found that the maxima of all the spectra were located at the same area; this is especially noticeable if the limiting energies of the spectra at various depths are plotted on the same abscissa. The data obtained confirmed the previously reached conclusion that D_1 remains constant. This rule is valid as long as about 7 to 10% of the original flux at the surface still persist after the filtering effect of the medium; upon additional filtering the spectrum becomes noticeably softer. (TTT)

10983 ANGULAR DISTRIBUTION OF β-RAYS FROM THICK-LAYER SOURCES. F. K. Levochkin and Yu. Ya. Sokolov. Atomnaya Energ., 12: 53-4(Jan. 1962). (In Russian)

The specific activity of materials may be measured by determining the yield of β-particles at the surface of a source with a thickness larger than the mean free path of the particles. This value is proportional to the specific activity and does not change with further increase of the thickness. This requires knowledge of the angular distribution of the particles. A method was developed involving the measurement of the absorption and scattering of the β-radiation from a point source placed between a thick support and foils of various thickness made of Al, Cu, Sn, and Pb. The measurements were carried out by means of a vacuum chamber and an end-window chamber, obtaining the angular distribution of the β-radiation of W^{185}, Tl^{204}, P^{32}, and Sr^{90} + Y^{90}. Results showed that the angular distribution does not depend on the energy of the radiation and the atomic number of the source. The flux from the thick-layer source in the direction of the window may be computed by Lambert's formula, derived in 1892. (TTT)

10984 MEASUREMENT OF THE INELASTIC COLLISION CROSS SECTION OF NEUTRONS WITH CHROMIUM, IRON, NIOBIUM, NICKEL AND MOLYBDENUM NUCLEI. A. I. Abramov. Atomnaya Energ., 12: 62-4(Jan. 1962). (In Russian)

The total cross sections of all the inelastic processes and in some cases the partial cross sections of inelastic scattering were measured in an inverse spherical geometry by the excitation of separate levels. A proton-irradiated tritium target of an electrostatic accelerator and a small ionization chamber filled with a mixture of He^3 + Ar were used as neutron source and detector, respectively. The spectra of pulses obtained with and without spheric specimens made of the natural isotopic mixture of the materials under study were examined, comparing the peaks due to primary neutrons. The anisotropy of the neutrons was taken into consideration in the calculations. The average excitation energies determined from inelastic neutron scattering were found to be 0.8 and 1.0 Mev for Nb and 0.8 and 1.1 Mev for Mo. Comparison of the data obtained with those calculated by means of W. Hauser and H. Feshbach's method (Phys. Rev. 87: 366 (1952) shows occasional divergences. It is concluded that the average energy of the inelastically scattered neutrons does not depend strongly on the energy of the primary neutrons even when the number of the excited levels is small. (TTT)

10985 IONIZATION CHAMBER TECHNIQUE FOR STUDIES OF EXCITED STATES AND ANGULAR CORRELATION OF FISSION FRAGMENTS. L. R. Khare and R. R. Roy (Pennsylvania State Univ., University Park). Brit. J. Appl. Phys., 13: 80-2(Feb. 1962).

Angular correlations between the directions of gamma emission at 0.7 and 1.3 Mev and associated fission fragments were studied by a special electronic technique in conjunction with a multigrid ionization chamber and were found to be isotropic. It was observed that more than one fragment of a fission can emit the same gamma ray. (auth)

10986 REARRANGEMENT COLLISIONS IN THE BORN APPROXIMATION. M. Demeur and C. Joachain (Université Libre, Brussels). Bull. classe sci. Acad. roy. Belg., (5) 47: 368-81(1961). (In French)

The asymptotic behavior of the total wave function furnishes a criterion for the validity of the Born approximation; the masses of the particles involved in the process are the only parameters appearing in the criterion. Some cases of atomic or nuclear collisions were investigated; the information given by the criterion are in good agreement with the conclusions deduced from a comparison between explicit calculations and experimental results. (auth)

10987 A CALORIMETRIC DETERMINATION OF THE HALF-LIFE OF THORIUM-230 AND A CONSEQUENT REVISION TO ITS NEUTRON CAPTURE CROSS SECTION. R. W. Attree, M. J. Cabell, R. L. Cushing, and J. J. Pieroni (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 40: 194-201(Feb. 1962). (AECL-1422)

The half life of Th^{230} (ionium) was measured by a calorimetric method and found to be 75200 years with a standard error of ±1600 years. Previously published values for the 2200 m/sec neutron capture cross section and the resonance capture integral (from 0.5 ev to ∞) of Th^{230} were amended to 22.7 ± 0.6 and 996 ± 40 barns, respectively. (auth)

10988 EVIDENCE FOR A 789.99-kev LEVEL IN Os^{188}. R. L. Graham, J. S. Geiger, R. A. Naumann, and J. M. Prospero (Atomic Energy of Canada Ltd., Chalk River, Ont. and Princeton Univ., N. J.). Can. J. Phys., 40: 296-9(Feb. 1962). (AECL-1425)

Electron-gamma coincidence measurements are made using a plastic-phosphor scintillation electron detector for the focused conversion line and a 3 × 3 in. NaI(Tl) scintillation spectrometer for γ radiations. Coincidence rates are normalized to correspond to the same number of de-

tected conversion electrons. The 478.07- and 634.96-kev γ transitions are coincident with the 155.03-kev γ transition while the 633.07-kev transition is not. To uniquely establish the position of the 634.96-kev transition in the Os^{188} level sequence, energies of four other transitions between the low-lying levels are measured. Energy-sum consistency is obtained within experimental errors. (L.N.N.)

10989 THE SPECTRUM OF ELECTRONS EMITTED IN THE TRANSITION $Au^{191} \rightarrow Pt^{191}$. José Sant'Ana Dionisio (Centre National de la Recherche Scientifique, Orsay, France). Compt. rend., 254: 257-9(Jan. 8, 1962). (In French)

Two magnetic spectrographs having semicircular focusing are used to study the Auger and internal conversion electron spectra from the transition $Au^{191} \rightarrow Pt^{191}$, in the energy range 0 to 116 kev. The multipole orders of the 30.48-, 48.58-, and 91.12-kev γ rays are established. (tr-auth)

10990 A POSSIBLE METHOD FOR THE INVESTIGATION OF NUCLEAR INTERACTIONS AT HIGH ENERGIES. V. A. Toomanyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 14: No. 3, 149-60(1961). (In Russian)

A new approach is proposed for the study of nuclear interactions at high energies. The approach, by means of a statistical method, allows one to obtain information concerning the physical characteristics of these processes. Only sparse data exist at present concerning these processes. An excess strangeness is defined as the difference between the total strangeness produced in a secondary reaction and the corresponding total strangeness for reactions induced at the same energies by the accelerated particles. These differences are determined separately for negative and positive strangeness and the total excess is the sum of the absolute value of the two differences. The study of strangeness excess can give information on the frequency of particle generation and on their energetics and angular distributions and even provides the subdivision of data into the creation of K mesons and hyperons. This information can be obtained in the study of secondary interactions up to primary interaction energies, E_0, of 100 to 500 Bev. For tertiary interactions E_0 is limited by the existence of experimental possibilities for the detection of interactions. To obtain accurate data in the study of secondary nuclear reactions for determining the excess strangeness it is necessary to know the experimental statistics significantly. (TTT)

10991 THE PURIFICATION AND ABSOLUTE DETERMINATION OF ^{99}Mo AND THE NEUTRON CAPTURE CROSS-SECTION OF ^{98}Mo. M. J. Cabell (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. & Nuclear Chem., 21: 1-9(Dec. 1961). (In English)

Procedures are described for the purification of neutron-irradiated, enriched Mo^{98} by anion exchange chromatography and the absolute determination of Mo^{99}. These procedures are used in a determination of the reactor and thermal neutron capture cross sections and the resonance capture integral of Mo^{98} by an activation method. Assuming 98.8 barns for the thermal neutron capture cross section of Au^{197}, values of $\hat{\sigma} = 0.377 \pm 0.007$ barns (for $r\sqrt{(T/T_0)} = 0.032$) and $\sigma_0 = 0.136 \pm 0.003$ barns were obtained for Mo^{98}. The resonance capture integral (from 0.5 ev to ∞) was found to be 6.69 ± 0.13 barns relative to 1558 barns for the resonance capture integral of Au^{197}. (auth)

10992 CALCULATED FORMATION CROSS-SECTIONS OF Ca^{45} AND Ca^{47}. I. Dostrovsky and Z. Fraenkel (Weizmann Inst. of Science, Rehovoth, Israel). J. Inorg. & Nuclear Chem., 21: 10-14(Dec. 1961). (In English)

The formation cross sections of Ca^{45} and Ca^{47} were computed as a function of bombarding energy. The nuclear reactions considered were the bombardment of Ti^{48} and Ti^{50} with neutrons and deuterons and the bombardment of Ca^{48} with neutrons, protons, deuterons, He^3 and He^4 particles. The calculations assume the formation of an excited compound nucleus with the subsequent de-excitation through nuclear evaporation. The effect of various assumptions is discussed. It is concluded that for the purpose of large scale production of Ca^{47}, the $Ca^{48}(n,2n)Ca^{47}$ reaction is by far the most useful of all reactions considered. (auth)

10993 RANGES OF FISSION FRAGMENTS IN GASES. I. RANGES IN AIR OF FRAGMENTS FROM SPONTANEOUS FISSION OF ^{252}Cf. K. V. Marsh and J. A. Miskel (Univ. of California, Livermore). J. Inorg. & Nuclear Chem., 21: 15-20(Dec. 1961). (UCRL-6259-T). (In English)

Differential ranges in air were measured for nineteen fission products of known mass resulting from the spontaneous fission of Cf^{252}. A comparison is made with the measured fission fragment ranges from Pu^{239} and a kinetic energy-range correlation obtained. (auth)

10994 ANALYSIS OF NUCLEON-NUCLEUS COLLISION OF ENERGY AROUND 100 GeV. Shigeo Matsumoto (Osaka City Univ.). J. Phys. Soc. Japan, 17: 1-5(Jan. 1962). (In English)

Experimental data of nucleon-nucleus collisions of energies around 100 Bev were analyzed. It is pointed out that the transverse momentum, p_T, of shower particles is also an adequate parameter to analyze the nucleon-nucleus collision. The transverse momenta, both in the average value and in the distribution, are similar to the case of the nucleon-nucleon collision. Both the median angle and the average number of shower particles increase with the number of heavily ionizing prongs, N_h. The latter observations exclude the possibility that, for primary energy at least up to ten Bev, the target of events with high N_h is effectively a single nucleon. Although conclusive rejection of the model of cascade development (of nucleon-nucleon and pion-nucleon collisions) is not presented, this model seems to be disagreement with the data of p_T. Existing data can reasonably be explained by the model of a simultaneous collision between an incident nucleon and a lump of nucleons. The model of simultaneous collision is thus preferable to the cascade model. (auth)

10995 SEARCH FOR WEAK GAMMA-RAYS OF ^{47}V. Jian-zhi Ruan, Yasukazu Yoshizawa, and Yujiro Koh (Osaka City Univ.). J. Phys. Soc. Japan, 17: 6-9(Jan. 1962). (In English)

Decay of V^{47} was investigated using a two-directional focusing beta spectrometer and NaI scintillators (2 in. 3 mm thickness). Two gamma rays of 1.54 and 1.87 Mev were found, and their intensities are 1.4 and 0.9% of the positron decay, respectively. The upper limit for 0.16-Mev photons is 0.08% of the positron decay. The maximum energy of the positrons from V^{47} is 1.90 ± 0.04 Mev. (auth)

10996 ELASTIC SCATTERING OF PROTONS FROM B^{11}, Al, P, Co, AND Cu FROM 6 TO 7.4 MeV. Kiichi Kimura, Yoshiaki Uemura, Ryutaro Ishiwari, Jun Kokame, Kiyoji Fukunaga, Akira Katase, Jiro Muto, Isao Kumabe, Hiroshi Ogata, Taro Ohama, and Yasuya Ohmori (Kyoto Univ.). J. Phys. Soc. Japan, 17: 9-18(Jan. 1962). (In English)

Energy dependence of angular distributions of protons elastically scattered by B^{11}, Al, P, Co, and Cu was measured in the energy range from 6 to 7.4 Mev. No remarkable energy dependence of the pattern of the angular distributions was found in all the energy and angular ranges studied.

It may be concluded that less energy dependence of the angular distributions of protons elastically scattered by the odd nuclei is due to less contribution and moreover less energy dependence of the compound elastic scattering. (auth)

10997 ANGULAR DISTRIBUTIONS OF THE ALPHA PARTICLES FROM THE (p,α) REACTIONS ON Na^{23} AND K^{39} AT 6.9 ~ 7.3 MeV. Teruo Nakamura, Kunio Takamatsu, Akira Masaike, Sigeru Kakigi, Dai Ca Nguyen, Sukeaki Yamashita, and Takuji Yanabu (Kyoto Univ.). J. Phys. Soc. Japan, 17: 19-23(Jan. 1962). (In English)

Angular distributions of the reactions $Na^{23}(p,\alpha)Ne^{20}$ and $K^{39}(p,\alpha)Ar^{36}$ leading to the ground and first excited states of the residual nuclei were measured at 6.9, 7.1 and 7.3 Mev of the incident proton energy, respectively, using a semiconductor detector. For the reaction $Na^{23}(p,\alpha)Ne^{20}$ the angular distributions of these alpha particles are almost 90° symmetrical at 7.1 Mev of the incident proton energy, and are slightly unsymmetrical about 90° at 7.3 and 6.9 Mev. For the reaction $K^{39}(p,\alpha)Ar^{36}$, the angular distributions are almost 90° symmetrical at all energies of the incident protons. It is considered that the reactions $Na^{23}(p,\alpha)Ne^{20}$ and $K^{39}(p,\alpha)Ar^{36}$ leading to the ground and first excited states of the residual nuclei, at around 7 Mev of incident proton energy, occur through a compound nucleus process, and in the former reaction the number of the compound states excited by the approximately 7-Mev protons are probably not so many as to justify the statistical assumption. (auth)

10998 CALCULATION OF α-DECAY CONSTANTS IN THE NEIGHBORHOOD OF Pb^{208}. H. D. Zeh and H. J. Mang (Universität, Heidelberg, Ger.). Nuclear Phys., 29: 529-43(Feb. 1962). (In German)

The α-decay-constants of certain nuclei near Pb^{208} are calculated by using shell model wave functions with realistic radial functions and considering configurational mixing. Ground state wave functions of Po^{211} and Bi^{211} are computed. Close agreement with experiment is obtained for all relative α-decay data in even odd-proton and odd-neutron nuclei. Results suggest the possibility of predicting E2 to M1 ratios of angularly correlated γ-rays. The spin of the Po^{211} isomeric state is determined as $^{25}/_{2}$. The failure of the calculation of absolute values on the shell model basis is discussed. (auth)

10999 PRODUCTION OF HEAVY FRAGMENTS IN THE REACTION $O^{16} + O^{16}$. P. G. Roll and F. E. Steigert (Yale Univ., New Haven). Nuclear Phys., 29: 565-81(Feb. 1962). (In English)

Heavy fragments produced in the bombardment of an oxygen target with 10 Mev per amu (atomic mass unit) oxygen ions were investigated using a proportional counter-CsI scintillator telescope. This arrangement permitted identification of the nuclear charge (species) of fragments from lithium through neon, as well as measurement of the energy spectra of each species. Mechanisms apparently contributing to the observed yields are discussed. Marked group structure, typical of direct pickup-type reactions, is evident at forward angles in the carbon and neon spectra. Groups are also seen in cases suggestive of particle decay following simple transfer-type reactions. A smooth, broad distribution characteristic of several-body breakup occurs in all cases. (auth)

11000 DECAY SCHEMES OF EXCITED STATES IN Mg^{24} AND Si^{28} AND THE COLLECTIVE MODEL. A. V. Cohen and J. A. Cookson (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Phys., 29: 604-22(Feb. 1962). (In English)

Gamma decay modes of the first six excited states of Mg^{24} and the first four of Si^{28} were determined using inelastic proton scattering. Mg^{24} was interpreted both on the axially symmetric rotational-vibrational, and the rotating triaxial ellipsoid collective models. The decay modes require, on the former model, <2% amplitude band mixing; they imply $\gamma \approx 14°$ on the latter model, while the positions of the spin 2 levels suggest $\gamma = 22°$. The higher Si^{28} levels cannot be explained on either model. Thus Mg^{24} is more susceptible to a deformed nucleus collective model interpretation than Si^{28}; this is correlated with the known greater nuclear deformation of Mg^{24}. (auth)

11001 AXIAL ASYMMETRY IN EVEN RARE EARTH NUCLEI. Ila Dutt and Paresh Mukherjee (Saha Inst. of Nuclear Physics, Calcutta). Nuclear Phys., 29: 623-34 (Feb. 1962). (In English)

The γ-stability of rare earth nuclei, whose quadrupole deformation β is around +0.28, was investigated by calculating the energies of individual nucleons in a completely anisotropic harmonic oscillator potential with spin-orbit coupling. (auth)

11002 THE HALF-LIFE OF V^{50}. D. E. Watt and R. L. G. Keith (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Phys., 29: 648-56 (Feb. 1962). (In English)

Examination of the gamma spectrum from 5 kg of spectrographically pure vanadium metal using a giant sodium iodide crystal indicates that naturally occurring V^{50} decays by negaton emission and by electron capture with partial half lives of $1.8 \pm 0.6 \times 10^{16}$ and $8.9 \pm 1.6 \times 10^{15}$ y, respectively. It is shown that the degree to which natural uranium and thorium occur in the source material must be accounted for in the measurement of very low specific activities. The importance of correcting for changes in the natural background spectrum shape caused by the different absorption for the cosmic radiation and local radioactivity in the presence of large amounts of source material are discussed. (auth)

11003 DECAY OF Rh^{106}. S. Y. Ambiye and R. P. Sharma (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys., 29: 657-64(Feb. 1962). (In English)

The decay of 30-sec Rh^{106} was studied using the techniques of coincidence scintillation spectrometry and Siegbahn-Slätis intermediate image beta-ray spectrometer. The gamma spectrum was studied by putting the source inside the well of 7.6 cm × 7.6 cm NaI(Tl) crystal and also by putting it outside the crystal. The highest energy level in Pd^{106} is identified at 3.1 Mev and the gamma-ray of highest energy is 2.87 Mev. The γ-γ coincidence spectra (along with other coincidences) indicate the 0.624-Mev gamma to be in coincidence with the 1.140-Mev gamma and the 1.050-Mev gamma to be in coincidence with the 0.870 and 1.050-Mev gamma. The energies, intensities and log ft values of beta-groups terminating at 0, 513, 1140, and 1560 kev levels were determined using a 40-nanosec resolving time coincidence arrangement, which is set up in conjunction with the beta-ray spectrometer. The possibility of a first octupole vibrational level in the region of 2.8 Mev is discussed. (auth)

11004 GAMMA SPECTRUM AND COINCIDENCE STUDIES OF Ru^{100}. B. Basu and A. P. Patro (Saha Inst. of Nuclear Physics, Calcutta). Nuclear Phys., 29: 672-9(Feb. 1962). (In English)

Gamma rays of Ru^{100} were using a scintillation counter. All the gamma rays observed by Marquez were confirmed and in addition some high energy gamma rays (2.78 and

2.25 Mev) were observed. Lower energy gamma rays were also observed. From coincident studies a level scheme similar to that of Marquez was proposed except for a level at 2.78 instead of at 3.21 Mev. (auth)

11005 ON THE MECHANISM OF THE $B^{10}(d,p)B^{11*}$ STRIPPING REACTION. Nőra Menyhárd and J. Zimányi (Central Research Inst. of Physics, Hungarian Academy of Sciences, Budapest). Nuclear Phys., 29: 678-9(Feb. 1962). (In English)

The effect of the non-central part of neutron-target interaction is investigated in (d,p) stripping reactions. The neutron, being captured with given orbital angular momentum, may transfer additional angular momentum to the target nucleus. This mechanism can explain the angular distribution of the protons from the $B^{10}(d,p)B^{11*}$ (first exc. state) reaction in the region of $E_{deut}<1$ Mev. (auth)

11006 NUCLEAR PARAMETERS OF THE $Be^9(d,p)Be^{10}$ REACTION. W. T. Pinkston (Vanderbilt Univ., Nashville). Nuclear Phys., 29: 690-3(Feb. 1962). (In English)

The parameters of the reaction $Be^9(d,p)Be^{10}$ were studied from the standpoint of the direct reaction theory. Intermediate coupling shell model wave functions were assumed for the nuclear states involved. Agreement was obtained for all quantities except the proton polarization, which may indicate that the neglect of spin-orbit coupling in the distorted waves is not justified. (auth)

11007 A NEW SEMI-EMPIRICAL MASS FORMULA. R. Ayres, W. F. Hornyak, L. Chan, and H. Fann (Univ. of Maryland, College Park). Nuclear Phys., 29: 212-40(1962). (In English)

A semi-empirical expression is developed for the binding energy of nuclear species resembling the usual Bethe-Weizsäcker form. Stability conditions require the adjustment of a two-parameter nuclear density distribution with mass number A, yielding for the normally constant coefficients in the usual expression values which are slowly varying functions of A. The extrapolation of the volume coefficient to the case of an infinitely large nucleus is ambiguous. Two extrapolations lead to 14.75 and 13.81 Mev per nucleon. (auth)

11008 RESONANCES IN F^{19} + p REACTIONS AT 224 AND 340 keV PROTON ENERGIES. L. Keszthelyi, I. Berkes, I. Demeter, and Ilona Fodor (Central Research Inst. of Physics, Budapest). Nuclear Phys., 29: 241-51 (1962). (In English)

Measuring the angular distribution and α-γ correlation on the 6.14-Mev γ radiation and α rays from the resonance at 224 kev in the $F^{19}(p,\alpha\gamma)O^{16}$ reaction, spin and parity 2^- were assigned to the 13.086-Mev excited level in Ne^{20}. The relative intensities of the 11.56-Mev M1 γ rays from the $F^{19}(p,\gamma)Ne^{20}$ and the 6.14-Mev γ rays from the $F^{19}(p,\alpha\gamma)O^{16}$ reaction at 340 kev proton energy were determined. The intensity ratio was found to be $I_{11.56}/I_{6.14} = (1.0 \pm 0.2)\cdot 10^{-1}$. Thus it is found that $\Gamma_{\gamma\,11.56} = 0.20 \pm 0.056$ ev. (auth)

11009 NUCLEAR THREE-BODY FORCES. Jun-ichi Fujita (Indiana Univ., Bloomington), Mitsuji Kawai, and Makoto Tanifuji. Nuclear Phys., 29: 252-67(1962). (In English)

The three-body nuclear potential is calculated assuming that: three pions are exchanged among three nucleons; the static pion theory is valid without pion-pion interactions. The obtained expressions are very complicated, so that numerical calculations are carried out only in the case of the triton forming an equilateral triangle. The result is compared with the previously calculated three-body potential due to two-pion exchange. It is found that the latter is predominant if the length of a side is more than 0.8 $\hbar/m_\pi c$. (auth)

11010 FAST-NEUTRON-INDUCED FISSION CROSS SECTIONS OF Pu^{241} AND Am^{243}. Daniel K. Butler and Ruth K. Sjoblom (Argonne National Lab., Ill.). Phys. Rev. 124: 1129-31(Nov. 15, 1961).

The cross sections for neutron-induced fission of Pu^{241} for neutrons of energies from 0.02 to 1.80 Mev and of Am^{243} for neutrons of energies from 0.3 to 1.7 Mev were determined by measuring the ratio of each cross section to that of U^{235} using a back-to-back gas scintillation counter. (auth)

11011 ISOTOPIC IDENTIFICATION OF NEUTRON RESONANCES OF Cd, Sb, Os, AND Pt FROM CAPTURE GAMMA-RAY SPECTRA. H. E. Jackson and L. M. Bollinger (Argonne National Lab., Ill.). Phys. Rev. 124: 1142-52(Nov. 15, 1961).

The Argonne fast chopper was used with a 3-variable magnetic-tape recording system to demonstrate the high efficiency and sensitivity of isotopic identification of neutron resonances by observation of capture γ rays. A discussion of features of capture spectra that can be useful in isotopic assignment is presented with results for resonances in natural Cd, Sb, Os, and Pt. The experimental study reported emphasizes primarily the observation of coincident γ rays as a means of measuring binding energies and characteristic low-energy lines of nuclides giving rise to resonant capture. The isotopic assignments include 23 resonances in Cd between 18 and 235 ev, 6 of which were previously unassigned; 20 resonances in Sb between 5 and 200 ev; 23 resonances in Os between 6 and 61 ev; and two resonances at 67 ev assigned to Pt^{195}. The data lead to observed level spacings of 33 ev in Cd^{111}, 80 in Cd^{112}, 27 in Cd^{113}, 27 in Sb^{121}, 12 in Sb^{123}, and 5.1 in Os^{189}. Strength functions for Cd^{111} and Cd^{113} based on the identifications are in agreement with previous reported values. For Os^{189}, from transmission data previously unreported, the value $\Gamma_n^0/D = (2.0^{+2.2}_{-0.7}) \times 10^{-4}$ is obtained. (auth)

11012 $T(d,n)He^4$ REACTION AS A SOURCE OF POLARIZED NEUTRONS. R. B. Perkins and J. E. Simmons (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 124: 1153-4 (Nov. 15, 1961).

Neutron polarization from the source reaction $T(d,n)He^4$ was measured at 30 and 90° at 0.1 to 7.7 Mev. At E_d = 5 Mev, an angular distribution of the polarization was measured. The polarization, which is small at low energies, at E_d = 7.7 Mev attains values of +0.64 and −0.52 at 30 and 90°, respectively. The Basel sign convention is used. The polarization was analyzed using a liquid helium scintillator in coincidence with a plastic scintillator. (auth)

11013 EXCITATIONS OF TWO-PHONON SURFACE VIBRATIONS IN NUCLEI. R. H. Lemmer, A. de Shalit, and N. S. Wall (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. 124: 1155-62(Nov. 15, 1961).

The features of inelastic scattering leading to two-phonon surface vibrations were examined in the Born approximation. Comparison is made with results of inelastic alpha scattering experiments on spherical nuclei. Agreement is found between parameters derived from these experiments and Coulomb excitation. The comparisons were carried out in a relatively model-independent way. (auth)

11014 APPROXIMATION METHODS IN NUCLEAR INTERMEDIATE COUPLING APPLIED TO THE 1p SHELL. Daniel S. Koltun (Princeton Univ., N. J.). Phys. Rev. 124: 1162-78(Nov. 1961). (PUC-1961-38)

The intermediate-coupling shell model for nuclei is considered in terms of the classification of states in a harmonic

oscillator according to the irreducible representations of the unimodular group in three dimensions, SU_3. The properties of this group are used to produce the approximate spectrum of a quadrupole force, acting within an oscillator shell. When specialized to the 1p shell, a more general interaction, including exchange forces, is shown to be approximately diagonal in the chosen representation, and its approximate spectrum is computed. A method is developed for calculating the matrix elements of interactions not diagonal in the representation, in particular the single-particle spin-orbit potential, using the generating functions of the group, SU_3. The intermediate-coupling energy spectra of the nuclei of the 1p shell are then calculated to the first or second order in perturbation theory. The results are compared with experimental spectra, and with calculations of Kurath (D. Kurath, Phys. Rev. 101: 216(1956)). (auth)

11015 QUANTUM MECHANICAL CALCULATION OF MÖSSBAUER TRANSMISSION. Samuel M. Harris (Univ. of Illinois, Urbana). Phys. Rev. 124: 1178-85(Nov. 15, 1961).

A quantum mechanical calculation of the time-dependent Mössbauer transmission is performed neglecting solid-state effects. The source considered consists of nuclei which decay via a two-photon cascade, the second of which is emitted without recoil and is subject to resonant absorption by a foil, the resonance of which may be shifted due to a small relative velocity between source and absorber. The transmission is obtained when the transmitted recoilless photon is measured in coincidence with the first photon of the cascade. The result is in agreement with that obtained by considering the absorber as a classical dieletric slab capable of absorption and dispersion. The initial condition is investigated in detail by considering the full cascade. It is seen that the assumption that the nucleus is in the first excited state immediately after the emission of the first photon gives the correct boundary condition. (auth)

11016 M3 ISOMERIC TRANSITION IN TIN-113. M. Schmorak, G. T. Emery, and G. Scharff-Goldhaber (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 124: 1186-9(Nov. 15, 1961). (BNL-5578)

The isomeric state of Sn^{113} is produced by thermal neutron irradiation of tin enriched in Sn^{112}. Its half-life is found to be (20 ± 1) min. The scintillation spectrum shows K x rays and a single gamma ray of 79 ± 3 kev. The K-conversion coefficient (ϵ_K = 95 ± 15) and the half life show that this isomeric transition is M3, and not M4, as was reported. A (9 ± 2)% electron capture branch from the isomeric state was found, and an upper limit of 10^{-4} was placed on the ratio of positron emission to electron capture. The latter value limits the decay energy to the ground state of In^{113} to ≤1.15 Mev. Spins and parities of $\frac{7}{2}^+$ for Sn^{113m} (20 min) and $\frac{1}{2}^+$ for Sn^{113g} (118 day) are assigned. The isomeric ratio $\sigma(Sn^{113m})/\sigma(Sn^{113g})$ was found to be (0.41 ± 0.06), and a value of (0.35 ± 0.08) barn was obtained for the production cross section of the isomer. (auth)

11017 (d,p) POLARIZATION MEASUREMENTS OF EXCITED-STATE REACTIONS. W. P. Johnson and D. W. Miller (Indiana Univ., Bloomington). Phys. Rev. 124: 1190-8(Nov. 15, 1961).

A helium gas polarimeter was build for use with a heavy-particle magnetic spectrometer, which allows measurements to be made of the polarizations of proton groups corresponding to nearby nuclear states. The polarimeter was calibrated by measuring the left-right asymmetry of second-scattered recoil protons from a hydrogen target bombarded by 21.8-Mev alpha particles. The following (d,p) polarizations were measured at a deuteron energy of 10.8 Mev and a laboratory scattering angle of 12.5°, listed according to the residual nuclear state and using the quantization axis $n = k_d \times k_p$. C^{13} ground state: −0.32 ± 0.05; C^{13} 3.09-Mev state: +0.03 ± 0.04; Mg^{25} 3.40-Mev state: −0.05 ± 0.05; Ca^{41} 1.95-Mev state: +0.014 ± 0.043; Ca^{41} 3.95-Mev state: −0.21 ± 0.05. The Mg result agrees within experimental errors with the polarization magnitude predicted from (d,pγ) angular correlation measurements made at a slightly different angle. If the two Ca states investigated are p-neutron states with j = $\frac{3}{2}$ and $\frac{1}{2}$, respectively, the ratio of the corresponding proton polarizations should be −0.5. The experimental ratio, which is subject to large error because of the near zero result for the 1.95-Mev state, is $-0.07^{+0.18}_{-0.28}$. This discrepancy may indicate the importance of spin-orbit forces in the distorting potentials. (auth)

11018 EFFECTS OF PARITY-NONCONSERVING INTERNUCLEON POTENTIAL OF Li^{7*}(0.478 Mev) → Li^7 GAMMA TRANSITION. R. J. Blin-Stoyle and R. M. Spector (Clarendon Lab., Oxford). Phys. Rev. 124: 1199-1200 (Nov. 15, 1961).

A calculation of the radiation anisotropy is made for the electromagnetic transition of Li^7 for the first excited state to the ground state on the assumption that a weak parity-nonconserving internucleon potential admixes into the two levels small amounts of wave function with the "wrong" parity and permits a small E1 transition to interfere with the normal M1 transition. The asymmetry is of the form $1 + \alpha \cos\theta$, and results give $|\alpha| \approx 10^{-3}$ assuming that the potential stems from the self-interacting current theory of weak interactions. (auth)

11019 STUDY OF Zr^{92} LEVELS EXCITED IN THE (d,p) REACTION. H. J. Martin, Jr., M. B. Sampson, and R. L. Preston (Indiana Univ., Bloomington). Phys. Rev., 125: 942-7(Feb. 1, 1962).

Seven energy levels in Zr^{92} were excited by the (d,p) reaction using 10.85-Mev deuterons. These levels were at excitation energies of 0, 0.94, 1.49, 1.86, 2.06, 2.91, and 3.28 Mev. The last two levels appear to be complex. Angular distributions were measured for all of these levels except the one at 1.86-Mev excitation. The distributions for the three lowest levels were d wave; the distributions for the three highest levels were s wave. Cross-section comparisons were made with earlier work on Zr^{91} levels. These comparisons indicated that the dominant configuration of the lowest levels is $(d_{5/2})^2$ and that the 2.91-Mev level is largely $(d_{5/2}s_{1/2})$. A calculation of the neutron-neutron interaction, using vacuum-like, singlet forces between the nucleons, gives fair agreement with the experimental results. (auth)

11020 LOW-RESOLUTION SURVEY OF (d,α) REACTIONS IN HEAVY NUCLEI. James B. Mead and Bernard L. Cohen (Univ. of Pittsburgh). Phys. Rev., 125: 947-55 (Feb. 1, 1962).

A low-resolution survey of (d,α) reactions was made for about 28 heavy nuclei between Z = 28 and Z = 83 with an incident deuteron energy of 15 Mev. Energy distributions and cross sections were obtained at scattering angles of 30, 60, 90, and 120°. The observed energy spectra are characterized by two strong peaks which vary regularly in energy and cross section with atomic weight. Energy distributions and cross sections of the low-energy peak are in accord with statistical theory. The principal features of the high-energy peak can be explained with the assumption of a process which involves the pickup of a proton and neutron from separate single-particle states. (auth)

11021 NEUTRON GIANT RESONANCES–A NUCLEAR RAMSAUER EFFECT. J. M. Peterson (Univ. of California, Livermore and Inst. for Theoretical Physics, Copenhagen). Phys. Rev., 125: 955-63(Feb. 1, 1962). (UCRL-5718)

Three continuous families of broad maxima and minima are observed in neutron total cross sections between 0.1 and 100 Mev. All shift smoothly to higher energy with increasing mass number. The relationships among the families, their energy-mass number dependence, and their detailed locations can be understood in terms of a semiclassical treatment of a simplified optical model. The oscillations are seen to result from interference between the part of the neutron wave which has traversed the nucleus with the part which has gone around. This nuclear situation is analogous to the Ramsauer effect in electron interactions with noble gases. An alternative explanation of the broad maxima as due to resonances of single partial waves is not valid because in general several partial waves are simultaneously important and because the partial wave characteristics change rapidly as one traverses a continuous family of maxima. The widths of the broad maxima are related more to the parameters of the real potential well than to the depth of the imaginary potential well. (auth)

11022 DEUTERON STRIPPING BY HEAVY NUCLEI. W. D. Barfield, B. M. Bacon, and L. C. Biedenharn (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 125: 964-7 (Feb. 1, 1962).

Theoretical angular distributions for the proton groups following bombardment of Pb^{206} and Bi^{209} by deuterons with energies less than 10 Mev are compared with experimental measurements of R. H. Stokes (Phys. Rev., 121: 613(1961)). Both theoretical and experimental angular distributions show peaking in the backwards direction, characteristic where Coulomb effects dominate the stripping. The theoretical curves fall off faster than the experimentally measured distributions, which show a tendency to level off in the region $\theta > 140°$. The insensitiveness of the stripping integral to the value of the cutoff radius parameter is demonstrated by numerical calculations. (auth)

11023 DECAY OF Sb^{115}. M. L. Sehgal (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 125: 968-71 (Feb. 1, 1962). (BNL-5721)

Sb^{115} (32 min) decays by electron capture and positron emission to Sn^{115}, the positron branch accounting for (12 ± 3)% of the disintegrations. Of the total disintegrations 94% lead directly to a previously known 499-kev level in Sn^{115}. The remaining 6% of the disintegrations are to an excited state in Sn^{115} and are followed by two gamma rays in cascade whose energies are 980 and 1240 kev, respectively. The crossover gamma ray of 2220 kev is also seen, with an intensity equivalent to 1% of the disintegrations. The cascade and crossover gamma rays lead to the 499-kev level and coincidences were observed between these gamma rays. An upper limit of 0.4% was obtained for a beta branch from In^{115m} to the 499-kev level in Sn^{115}. These levels in Sn^{115} seem to be too high in energy to correspond to the predicted low-lying levels. (auth)

11024 OPTICAL-MODEL ANALYSIS OF ELASTIC SCATTERING OF PROTONS ON CARBON AT INTERMEDIATE ENERGIES. J. S. Nodvik (Univ. of Southern California, Los Angeles), C. B. Duke, and M. A. Melkanoff. Phys. Rev., 125: 975-87(Feb. 1, 1962). (PUC-1961-46)

Differential cross sections and polarizations for proton elastic scattering by carbon at 7 to 20 Mev were analyzed using the diffuse-surface optical model of the nucleus. The model parameters were varied systematically, the best fits to the experimental data being determined by a method of least squares. Forms of the absorptive part of the potential were investigated, although the major part of the analysis was carried out using a surface-plus-volume absorption potential. It was found that the model could not account satisfactorily for the data below about 12 Mev, and the presentation of results is limited to the region $11.85 \leq E_{lab} \leq 19.4$ Mev. Excellent fits can be obtained over the latter region with generally reasonable values of the model parameters, although some features of their behavior as a function of energy remain to be explained. The most striking feature of the results is the thin absorptive shell and small volume absorption which characterizes the potential. Although the predicted reaction cross sections generally appear too low, the experimental data are not sufficiently precise to warrant drawing a definite conclusion. (auth)

11025 HIGH-RESOLUTION STUDY OF THE $B^{10}(He^3,p)C^{12}$ REACTION. C. P. Browne, W. E. Dorenbusch, and J. R. Erskine (Univ. of Notre Dame, Ind.). Phys. Rev., 125: 992-9(Feb. 1, 1962).

Proton groups from the $B^{10}(He^3,p)C^{12}$ reaction leading to levels up to 16.2-Mev excitation were analyzed with a broad-range spectrograph. At a bombarding energy of 3.74-Mev spectra were taken at 11 angles from 5 to 139 degrees. Levels were found at excitation energies of 4.43(7), 7.655 ± 0.006, 9.645 ± 0.006, 10.849 ± 0.025, 11.841 ± 0.025, 12.713 ± 0.006, 13.29 ± 0.03, 14.083 ± 0.015, 15.108 ± 0.006, and 16.108 ± 0.006 Mev. Widths of the 9.6-, 10.8-, 11.8-, 13.3-, and 14.1-Mev levels are 35 ± 6, 320 ± 30, 245 ± 30, 430 ± 100, and 252 ± 15 kev respectively. Widths of the other levels are less than 15 kev. No levels were found at excitations of 9.0, 11.1, or 15.6 Mev. A level 2 Mev wide at 10.1-Mev excitation would not be seen above the high background from three-particle breakup. Yields at each angle were measured relative to the yield of the $B^{10}(He^3,d)C^{11}$ reaction. An angular distribution was obtained. Absolute differential cross sections were found by comparing the yields with the known yield from the $B^{10}(d,p)B^{11}$ reaction. Cross sections for the $B^{10}(He^3,p)C^{12}$ reaction vary from 0.02 to 0.6 mb/steradian. (auth)

11026 ELASTIC SCATTERING OF POLARIZED 2.8-Mev NEUTRONS. K. V. K. Iyengar and R. A. Peck, Jr. (Brown Univ., Providence). Phys. Rev., 125: 1000-2 (Feb. 1, 1962).

The polarization produced in the elastic scattering at 90° of partially polarized 2.8-Mev neutrons by C, Mg, Al, Ni, and Cu was measured. All yield positive polarization. The polarizations produced by Ni and Cu are nearly the same whereas those produced by Al and Mg are very different. The polarization observed for carbon is in agreement with calculations from available phase-shift data. (auth)

11027 ELASTIC AND INELASTIC SCATTERING OF 28-Mev DEUTERONS. R. J. Slobodrian (Comisión Nacional de Energia Atómica, Buenos Aires). Phys. Rev., 125: 1003-10(Feb. 1, 1962).

Natural lithium, polyethylene, and aluminum targets were bombarded with 28-Mev deuterons. The outgoing particles were analyzed with a scintillation spectrometer. The angular distributions for the following processes were measured: $Li(d,d)Li$, $Li^7(d,d')Li^7-4.61$ Mev, $C^{12}(d,d)C^{12}$, $C^{12}(d,d')C^{12}-4.43$ Mev, $Al^{27}(d,d)Al^{27}$, $Al^{27}(d,d')Al^{27}-2.21$ Mev, and $H^1(d,p)H^2$. The $Li^7(d,d')Li^7$ 4.61-Mev angular distribution can be fitted by superimposing plane-wave direct-reaction curves corresponding to $l = 0$, $a = 3.4$ f and $l = 2$, $a = 3.9$ f, where a is the interaction radius and l

the angular momentum change; this leads to an odd parity assignment for the level. The angular distribution of the reaction $C^{12}(d,d')C^{12}-4.43$ Mev is fitted by superimposing the curves of l = 0, a = 4.1 f and l = 2 with a = 4.6 f. The $Al^{27}(d,d')Al^{27}-2.21$ Mev angular distribution is adequately fitted with a curve of l = 1, a = 5.1 f; therefore there follows an odd parity assignment for the level. The possible spin assignments of the levels are discussed. The inelastic scattering curves yield some evidence of a total spin flip of the deuteron in the reaction. The elastic scattering angular distributions show the usual diffraction pattern, and interaction radii were calculated using an optical analogy that implies the scattering of waves from a black disk. The angular distribution of the interaction $H^1(d,p)H^2$ is consistent with measurements performed at neighboring energies and it also agrees with the curve obtained with a Serber-type force. (auth)

11028 NEUTRON-INDUCED REACTIONS IN THIRD AND FOURTH SHELL NUCLEI. F. L. Hassler and R. A. Peck, Jr. (Brown Univ., Providence). Phys. Rev., 125: 1011-16(Feb. 1, 1962).

A counter telescope and scintillation spectrometer were used to obtain spectra and angular distributions (0 to 150° at 30° intervals) of the (n,p) reactions at 14 Mev with Mg, Al, Si, P, S, Ti, Fe, Co, Ni, and Zn. Contributions of (n,d) were separated by two independent experimental methods, and direct interaction contributions by the criterion of angular asymmetry. The residual yield was analyzed to give values of temperature (accuracy about 10%) and spin-dependence parameters (lower limits), which compare reasonably with independent values based on collected level information. Fractions of direct interaction are described by the model of Brown and Muirhead, (G. Brown and H. Muirhead, Phil. Mag., 2: 473(1957)) and total cross sections are consistent with available determinations by other methods. Angular distributions of strong (n,d) ground-state groups from P and S have the appropriate pickup forms. (auth)

11029 EXPERIMENTS ON PAIR AND TRIPLET PRODUCTION BY 5-90-Mev X RAYS. H. S. Sandhu, E. H. Webb, R . C. Mohanty, and R. R. Roy (Pennsylvania State Univ., University Park). Phys. Rev., 125: 1017-21(Feb. 1, 1962).

The energy partition between the positrons and electrons of 5787 pairs and 1872 triplets produced by a hardened beam of x rays of maximum energy 90 Mev, was investigated using a nuclear emulsion technique. The results agree approximately with theory. The relative total cross sections of triplet production agree, within experimental error, with theory, with an exchange correction. Similarly, the angular distributions of both pairs and triplets can be explained within experimental error. (auth)

11030 INELASTIC ELECTRON-NUCLEUS SCATTERING AND NUCLEON-NUCLEON CORRELATIONS. K. W. McVoy (Instituut voor Theoretische Fysica, Utrecht and Brandeis Univ., Waltham, Mass.) and L. Van Hove. Phys. Rev., 125: 1034-43(Feb. 1, 1962).

A constant-q and $-\theta$ sum rule is constructed in Born approximation for inelastic scattering of electrons on nuclei by integrating over the outgoing electron energy spectrum at constant 3-momentum transfer, q, and scattering angle θ. A consistent treatment of the nucleon current interaction through second order in q/M, the recoil nucleon velocity, gives a result reliable to 5–10% out to $q \sim 2.5$ f^{-1}, and shows that the often neglected Darwin-Foldy term contributes substantially. The q dependence of the sum can be directly related by closure to the Fourier transform of two-nucleon correlation functions in the ground state of the nucleus. The q dependence is studied for nuclear models of O^{16}; the effect of the Pauli exclusion principle on the sum is large for $q \sim 1$ f^{-1}, but the effect of a hard-core force of radius ≤0.4 f appears to be small for all values of q. (auth)

11031 ENERGETICS OF THE CHARGED PARTICLE-INDUCED FISSION OF Ra^{226}, Bi^{209}, AND Au^{197}. H. C. Britt, H. E. Wegner, and J. Gursky (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 8: 98-100(Feb. 1, 1962).

A back-to-back semiconductor counter system was used to study the energetics of 10.8 and 13.6-Mev deuteron-induced fission of Ra^{226} and 25-Mev He^3-induced fission of Au^{197} and Bi^{209}. Evidence for two distinct modes of Ra^{226} fission with the total kinetic energy release arising from Coulomb fragment repulsion was found. It is suggested that the fission process at moderate excitation energies is different from that at low energies. (L.N.N.)

11032 ANOMALOUS E2 INTERNAL CONVERSION COEFFICIENTS FOR ROTATIONAL TRANSITIONS. E. M. Bernstein (Univ. of Texas, Austin). Phys. Rev. Letters, 8: 100-3(Feb. 1, 1962).

Experimental evidence indicating that many conversion coefficients for enhanced E2 transitions between rotational states are not in agreement with theoretical values is given. Discrepancies are correlated with the ratio of neutrons to protons in the nucleus. (L.N.N.)

11033 PRODUCTION OF A QUASI-MONOCHROMATIC γ-RAY BEAM FROM MULTI-Gev ELECTRON ACCELERATORS. G. Barbiellini, G. Bologna, G. Diambrini, and G. P. Murtas (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy and Rome). Phys. Rev. Letters, 8: 112-13 (Feb. 1, 1962).

Measurements of electron pair production and bremsstrahlung from high-energy photons in a silicon single crystal were made. A "fine structure" was discovered in the coherent bremsstrahlung from the crystal. The bremsstrahlung cross section was calculated taking into account the actual structure of the crystal lattice planes. Calculations of the "fine structure" agree with results. Consequences in experiments using multi-Bev electron accelerators are discussed. (L.N.N.)

11034 NEW TERM IN THE NUCLEAR OPTICAL POTENTIAL: IMPLICATIONS FOR (p,n) MIRROR STATE REACTIONS. A. M. Lane (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Rev. Letters, 8: 171-2(Feb. 15, 1962).

It is shown that the nuclear optical potential depends on isotopic spin. If $\vec{t}$, $\vec{T}$ are the isotopic spins of incident nucleon and target nucleus of mass A, the dependence has the form $V = V_0 + A^{-1}(\vec{t}\cdot\vec{T})V_1$, where V_0 and V_1 are independent of isotopic spin but depend in general on position and momentum. The term in $(\vec{t}\cdot\vec{T})$ appears straightforwardly in a calculation of V taken as a sum of two-body forces with Heisenberg components and averaged over a Fermi gas. Practical consequences are discussed. (L.N.N.)

11035 OF THE MASS DIFFERENCE BETWEEN PROTON AND NEUTRON. Bronisław Średniawa (Jagellonian Univ., Krakow). Postępy Fiz., 11: 489-501(1960). (In Polish)

The mass difference between charged and uncharged pi mesons stems from the interaction of the meson with the electromagnetic field of the charged particle, since the internal energy of the neutral meson arising from this source is nearly zero. Standard methods of field theory obtain this interaction energy through the virtual emission and reab-

sorption of particles, in this case photons. A limit to the interaction energy is obtained by employing an upper limit or cutoff of the value of momentum q of the particle that undergoes virtual emission and reabsorption. The cutoff value of q, designated as Q, is of the order of Mc where M is the mass of the meson in this example, and c is the velocity of light. The significance of Mc is that at this value of momentum of the meson, the de Broglie wavelength h/Mc is equal to the dimensions of the particle in the corpuscular picture. This is the smallest region of space that the mesonic wave function can occupy. Analogous to the case of the charged meson, the interaction energy (positive or negative) of the proton with mesonic and electromagnetic fields can lead to a mass difference between proton and neutron. The theoretical foundations of this interaction energy are reviewed revealing both the strong points and defects of several theoretical approaches. It is concluded that the present theories are inadequate and provisional and that they should be replaced by a new theory that will probably have a completely different character. There are strong indications that in the new theory three universal constants will play an important role; the velocity of light, Planck's constant and a third that can be called an elementary unit of length, that could not be built into the formalism of present day theories. (TTT)

11036 PROPERTIES OF HIGHLY DEFORMED EVEN-EVEN NUCLEI. Stanisław Ogaza (Inst. of Nuclear Physics, Krakow). Postępy Fiz., 12: 577-97(1961). (In Polish)

A number of nuclear models are reviewed from the point of view of the particle-particle interaction that is inherent in each model. In the case of highly deformed nuclei, or nuclei whose value of A, the atomic number, is far from a magic number, those "interior" nucleons within the closed shell appear to play a negligible role in the collective nature of highly deformed nuclei. The interaction between the "exterior" nucleons, on the other hand, cannot be explained by the existence of a spherically symmetric central field that characterizes the interaction between closed-shell nucleons. The low-lying energy levels of highly deformed even-even nuclei are seen to have a structure characteristic of rotational levels. Quantitative expressions for the magnetic moment, the quadrupole moment and the moment of inertia are discussed. The dependence of moment of inertia on the deformation of the nucleus cannot be explained without taking into account the coupling between pairs of nucleons with opposite spins, and this dependence falls between a moment of inertia that is characterized by the rotational motion of an irrotational fluid (liquid drop model) and by the motion of a rigid rotator. Vibrational levels of highly deformed nuclei are much more difficult to treat since their energy levels are near those of the closed shell nucleons. However, the vibrational states do interact with the rotational energy levels, giving rise to the most important source of perturbation of these levels. (TTT)

11037 PRODUCTION OF As^{74} FROM NEUTRON IRRADIATED SELENIUM. V. I. Levin, M. M. Golutvina, and E. A. Tikhomirova. Radiokhimiya, 3: 597-600(1961). (In Russian)

The production of As^{71} in $Se^{74}(n,p)$ reactions is described. The preparation does not contain As^{73}. The yield of As^{74} was determined to be equal to ~0.12 μc/g of selenium in an irradiation of $\sim 7 \times 10^{13}$ n/cm^2 · sec for 470 hours. The effective cross section for the reaction was calculated for fission neutrons ($\sigma \approx 2.9$ mb) and results were correlated with experimental data ($\sigma \approx 1.6$ mb). (R.V.J.)

11038 MEASUREMENT OF Q_0 VALUES OF NUCLEAR REACTIONS BETWEEN LIGHT NUCLEI. A. Tejera, M. Mazari, A. Jáidar, and G. López (Universidad Nacional de Mexico, Mexico City). Rev. mex. fis., 10: 229-38(1961). (In Spanish)

A group of high Q_0 values, which presented exceptional discrepancies as compared to those computed in recent nuclear mass tables, were measured. Conditions of the Van de Graaff accelerator and broad-range magnetic spectrograph were improved by reorientation and adjusting the beam size to coincide with that of the Po-210 calibrator, through a reduction of its original height. The repeated high Q_0 value measurements as well as other reactions simultaneously observed are reported. In spite of some apparent better agreement with mass values, differences larger than the proposed errors still remain. There has not been a general improvement with respect to the earlier situation when analyzing, by the use of the present results, closed cycles among the light nuclei. Saturation effects of the magnetic and fringing fields of the spectrograph at high strengths might be a probable source to explain the discrepancies. (auth)

11039 Q_0 VALUES IN THE CARBON-NEON REGION FOR PRECISE DETERMINATIONS OF NUCLEAR TABLES. G. López (Universidad Nacional de Mexico, Mexico City) and O. Almén. Rev. mex. fis., 10: 239-45(1961). (In Spanish)

Measurements were made of the transition energies in the carbon-neon region under similar experimental conditions for mass determination purposes with gaseous targets enriched in N^{15}, O^{18}, Ne^{20}, and Ne^{22} embedded in metallic backings. A special holder was built to cool the metallic backing by running water in contact with it, and to prevent the gas from evaporating during bombardment. Adjustments in the holder allowed exposed areas to be shifted. (p,α), (d,α), and (d,p) reactions were observed in the N^{15} and O^{18} targets; (d,α) and (d,p) in Ne^{20}; and (d,p) in Ne^{22} at 90° laboratory angle. A comparison is made of the present data with published results. In general there is good agreement except in the $Ne^{20}(d,\alpha)F^{18}$ and the $O^{18}(d,\alpha)N^{16}$ reactions where discrepancies of nearly two times the published data were observed. The errors given are of the order of twice the standard deviation, covering uncertainties of absolute standards. (auth)

11040 DETERMINATION OF EXCITATION ENERGIES OF LIGHT NUCLEI AND THE PRIMARY INTERMEDIATES IN BEAM REACTIONS (d,p) AND (d,α). A. Jáidar, G. López, M. Mazari, and R. Domínguez (Universidad Nacional de Mexico, Mexico City). Rev. mex. fis., 10: 247-82(1961). (In Spanish)

In the systematic study of Q-value measurements for accurate mass determination purposes undertaken using a Van de Graaff and a broad-range magnetic spectrograph technique, a good number of particle groups corresponding to excited states of nuclei appeared in the surveyed region. The usual targets consisted of evaporated substances at high vacuum on Formvar films. Special gas embedded targets in metallic backings, such as N^{15}, O^{18}, Ne^{20}, and Ne^{22}, were prepared by electromagnetic separation. The analysis of the information confirmed in most cases, within the experimental errors, the excitation energies of previously reported levels. The detailed study of the higher excitation region from 3.9 to 5.5 Mev of Mg^{25} confirmed three doubtful reported levels and showed the appearance of six new ones; the precision has been considerably improved for another set of six levels in the same region. Comparisons with results of previous work are tabulated. (auth)

11041 DETERMINATION OF THE ANGULAR DISTRIBUTION OF THE GROUND AND FIRST EXCITED STATES OF O-17 AT MODERATE ENERGIES (1.6 Mev) IN AND

OUT OF A F-18 RESONANCE. Esther O. de López (Universidad Nacional de Mexico, Mexico City). Rev. mex. fis., 10: 283-307(1961). (In Spanish)

The angular distribution in the reaction $O^{16}(d,p)O^{17}$ (1) shows a remarkable increase of the cross section at higher angles. To determine more carefully this increase, studies were carried out using a Van de Graaff accelerator and a broad-range magnetic spectrograph. The resonance energy of the compound nucleus O^{16} + d was first established; angular distribution of the O^{17} ground and first excited levels were run at bombarding energies of 1.65 and 1.53 Mev, respectively, in and out of the F^{18} resonance (E_x = 8.99 Mev). The C^{13} (0) was observed too, when bombarding with 1.65-Mev particles. By comparing experimental curves with theoretical ones, obtained by the Butler theory, for both incident deuteron energies, it is possible to associate the neutron capture momenta $l_n = 2$ and $l_n = 1$ to the (d,p) reactions leading to the ground states of O^{17} and C^{13}, respectively; the values $l_n = 0$ and $l_n = 4$ can be fitted simultaneously to the O^{17} (1) state. Although the background is higher in resonance than out of it, both cases show a notable increase around 95° cms comparable with the measured intensity at 0°. The Butler theory seems not to be applicable to the observed shape of the 871-kev level in O^{17}, as it would lead to $l_n = 4$, which is not a reasonable assignment for O^{17} (1). (auth)

11042 THE THEORY OF NUCLEAR ROTATION. [PART] I. Hans Hackenbroich (Max-Planck-Institut fur Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 1068-76(Oct. 1961). (In German)

The expression proposed by Nilsson for the nuclear potential was introduced into the Inglis model of the rotating nucleus. Eigenstates, equilibrium deformations, and moments of inertia of g-g nuclei in the region of the rare earths were calculated from the model. The calculated moments of inertia are consistently larger than the measured moments, but the course of the calculated deformations and moments of inertia agree satisfactorily with theory. (tr-auth)

11043 THE THEORY OF NUCLEAR ROTATION. [PART] II. Hans Hackenbroich (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 1077-82(Oct. 1961). (In German)

The effect of residual interactions in the Inglis model of nuclear rotations is discussed. The interactions are idealized as contact potentials, and the one particle potentials are taken from Nilsson. In this model the expectation values of the residual interactions cannot be approximated by the "pairing energies," i.e., the binding energies of particles in the same orbit but with opposite z-components of angular momentum. For the nuclei calculated (Gd^{156}, Gd^{157}, and Gd^{158}) the residual interactions reduce the nuclear moments of inertia. However, with the strength parameter of the interactions set in order to obtain the correct sequence of nuclear levels, the calculated moments of inertia are still greater than the observed ones. The model cannot explain the difference between the moments of inertia of even and odd nuclei. (auth)

11044 THE THEORY OF NUCLEAR ROTATION. [PART] III. Hans Hackenbroich (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 1083-9(Oct. 1961). (In German)

The interplay of the quantum mechanical rotation of a core consisting of closed shells and nucleons outside the closed shells is considered. The core is characterized by its moment of inertia and its deformation is taken to be the same as the deformation of the one particle potential. Energies and wave functions of the system are calculated with the help of a variation method. The distortion of the wave function of the outer nucleons due to the rotation is considerably smaller than computed from first order perturbation theory. The Inglis formula for rotational energies is a limiting case of our energy equation. The core moment of inertia enters the model as a parameter. This parameter can be estimated from the vibrational energies of spherical nuclei and from the rotational-vibrational interaction, but the two values obtained are not in good agreement. In our example (Gd^{158}) only the second value gives the correct moment of inertia of the whole nucleus. (auth)

11045 β-γ CIRCULAR POLARIZATION CORRELATION IN K^{42}, Co^{56}, Rb^{86}, Ag^{110m}, AND I^{130}. H. Daniel, M. Kuntze, and O. Mehling (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Z. Naturforsch., 16a: 1118(Oct. 1961). (In German)

The β-γ circular polarization correlation was measured for K^{42}, Co^{56}, Rb^{86}, Ag^{110m}, and I^{130}, and the results are tabulated. The results in the permitted Co^{56} and Ag^{110m} transitions are in agreement with the isotope spin selection rule. (J.S.R.)

Particle Accelerators

Refer also to abstract 10271

11046 (MURA-432) COMPUTATIONAL SOLUTIONS OF THE TWO-DIMENSIONAL WAVE-EQUATION FOR A CROSS-SHAPED REGION. L. Jackson Laslett (Midwestern Universities Research Assn., Madison, Wis.). Sept. 26, 1958. Contract AT(11-1)-384. 19p.

Approximate computational solutions are obtained for the two-dimensional wave-equation, with $\Psi = 0$ on the boundary, for a cross-shaped region. The differential equation was replaced by a set of difference equations and the even eigenfunctions, with their associated eigenvalues, found by use of the GENDARME program. Solutions were obtained in this way for several ratios of arm-length to arm-width. When this ratio exceeded two or three, solutions for the lowest mode were found to be closely similar in the central region of the cross. Guided by the computational results, a form for a trial function is proposed which, by a variational method, permits a good analytic estimate to be made of the lowest eigenvalue and affords an approximate description of the associated wave function. (auth)

11047 (MURA-458) PARTICLE-PARTICLE COLLISIONS IN A STACKED BEAM. Adam Becher (Midwestern Universities Research Assn., Madison, Wis.). May 16, 1959. AT(11-1)-384. 12p.

The effect of electron-electron collisions on the longitudinal motion of electrons in the stacked beam of the two-way model was studied. It is shown that the energy loss due to collisions is very small compared to the energy loss due to radiation, and thus that the use of Liouville's theorem in μ-space is an excellent approximation. (auth)

11048 (MURA-464) ENERGY LOSS EFFECTS AND THE INSTABILITY OF A COASTING BEAM. A. M. Sessler (Midwestern Universities Research Assn., Madison, Wis.). Feb. 22, 1959. Contract AT(11-1)-384. 7p.

It is shown that an energy loss mechanism which results in a uniform rate of loss independent of velocity has no effect on the criterion for instability of a coasting beam. (auth)

11049 (MURA-495) PRELIMINARY ANALYTIC WORK ON NON-SCALING SPIRAL SECTOR FFAG ACCELERATORS. F. T. Cole (Midwestern Universities Research Assn., Madison, Wis.). Aug. 6, 1959. Contract AT(11-1)-384. 15p.

Approximate analytical results are given for non-scaling spiral sector FFAG Accelerators. The equilibrium orbit scalloping was calculated, as well as the betatron oscillation frequencies in the smooth approximation. The effects of derivatives of k, 1/w, and flutter appeared to be small; ν_x and ν_y were given fairly accurately by the local value of these parameters. The transition energy was determined essentially by the local value of k. (auth)

11050 (MURA-496) ON THE ADVISABILITY OF INJECTION FROM A CYCLOTRON. Avivi I. Yavin (Midwestern Universities Research Assn., Madison, Wis.). Aug. 10, 1959. Contract AT(11-1)-384. 23p.

A survey of some of the factors which determine the properties of a cyclotron beam is given. An effort was made to determine the characteristics of a beam as far as injection is concerned, and it is indicated why a 50-Mev cyclotron is at the present inferior to the 50-Mev linac. An 850-Mev cyclotron, however, is shown as a possible replacement for the 50-Mev linac injector. (auth)

11051 (MURA-511) OPERATING CHARACTERISTICS OF THE RF SYSTEM FOR THE WISCONSIN MODEL. Robert Stump (Midwestern Universities Research Assn., Madison, Wis.). Sept. 8, 1959. Contract AT(11-1)-384. 12p.

Changes in the parameters of the radiofrequency system of the Wisconsin Model two-beam electron accelerator and the reasons for them are described. The frequency-program, pickup, displacement system, and limitations on beam density are discussed. (M.C.G.)

11052 (NBS-TN-75) SOVIET RESEARCH IN FIELD ELECTRON AND ION EMISSION, 1955-1959. An Annotated Bibliography. Tibor W. Marton and Ralph Klein (National Bureau of Standards, Washington, D. C.). Oct. 1960. 39p. (PB-161576)

The bibliography includes references on field electron emission from metals and semiconductors, work functions, phase transformations, adsorption, and field ion emission. Over 100 references to technical literature for the period 1955 to 1959 are given and notations concerning English translations are provided whenever they are available. (J.R.D.)

11053 (UCRL-5430-T(Rev.II)) ACCELERATOR BEAM PULSING SYSTEM WITH EXTREMELY WIDE RANGE OF PULSE LENGTHS AND PULSE REPETITION RATES. Kristian Aaland (California. Univ., Livermore. Lawrence Radiation Lab.). June 28, 1960. Contract [W-7405-eng-48]. 11p.

A method for producing a burst of high energy particles by chopping a continuous beam of such particles is discussed. A system was devised which makes use of a "turn-on" and a "turn-off" pulse of fast rise time, spaced an adjustable time interval apart, to produce each beam pulse instead of using a sine wave. This system produces the desired square pulse shape, the successive pulses are exactly alike, and both pulse length and pulse repetition rate are easily variable over an extremely wide dynamic range. The circuit and principle of operation of this system are described. (auth)

11054 (UCRL-6669) A CROSSED BEAM MACHINE FOR MEASURING ATOMIC COLLISION CROSS SECTIONS. Gilbert O. Brink (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 12, 1961. Contract W-7405-eng-48. 21p.

A piece of experimental apparatus that was developed for measuring atomic collision cross sections is described. The experiments in progress with this crossed beam machine are discussed. (auth)

11055 ACCELERATION OF MULTIPLY CHARGED IONS IN THE CYCLOTRON OF 120-CM POLAR DIAMETER (Y-120). G. Indreas and Y. Oganesyan (Joint Inst. for Nuclear Research, Dubna, USSR). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 341-56(1961). (In Rumanian)

The problem of heavy ion acceleration in the 120-cm cyclotron (Y-120), actually used for proton, deuteron, and α particle acceleration is studied. It is shown that there are some transformations which affect only slightly the actual construction of an accelerator that can furnish ion beams with mass/charge ratios of 2 to 3.7 at an energy from 3 to 5 Mev/nucleon. (tr-auth)

11056 ENERGY DETERMINATION OF THE U-120 CYCLOTRON BEAM BY MEANS OF THE TIME-OF-FLIGHT METHOD. N. Martalogu, F. Ţintă, R. Dumitrescu, and T. M. Magda. Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 675-80(1961). (In Rumanian)

The external beam energy of the U-120 cyclotron was measured by means of the time-of-flight method, using the natural bunching of the beam. The experimental data are 5 to 7% lower than those calculated from the cyclotron frequency. These results agree with the previous energy determinations using the accelerated particle range in air. (auth)

11057 PARTICLE ACCELERATION AND ION YIELD TESTS WITH A CYCLOTRON PROVIDED WITH AN AZIMUTHALLY VARIABLE MAGNETIC FIELD AND WITH ADJUSTABLE ENERGY. A. A. Arzumanov, R. A. Meshcherov, E. S. Mironov, L. M. Nemenov, S. N. Rybin, and Yu. A. Kholmovskii. Atomnaya Energ., 12: 12-21(Jan. 1962). (In Russian)

Acceleration and ion yield problems were investigated with the help of the 1.5-m cyclotron of the I. V. Kurchatov Institute of Atomic Energy. The azimuthal variation of the magnetic field was accomplished by means of three 30-mm thick Fe sectors extending under an angle of about 60°, provided with correcting coils. These coils could vary the shape of the magnetic field, shift the ion beam in vertical direction without interfering with resonance conditions and correct the first harmonics of the non-homogeneity of the magnetic field. Special screening probes were used for determining the characteristics of the accelerated beams. At an ion current of about 70 microamp, a 31.5-Mev deuteron beam was successfully accelerated and taken out of the machine. The energy of the ions could be adjusted in the magnetic field range of 5 to 17 kilooersted. By means of a deflecting system it was found possible to reduce the divergence of the beam witout additional loss of the ion current thus allowing the use of small-aperture magnetic quadrupole lenses. The energy dispersion was found to be about ±1%. (TTT)

11058 PARTICLE STORAGE IN THE SYNCHROTRON. Yu. M. Ado. Atomnaya Energ., 12: 54-5(Jan. 1962). (In Russian)

Particle storage systems attracted great attention lately because they may be conveniently used for studying the behavior of elementary particles by means of the interaction of opposite beams. A novel storage system based on the time dependence of the component constant and variable

magnetic fields in the synchrotron is described. The efficiency of the particle storage operation of the machine is evaluated on the basis of the radial extinction of the amplitude of phase oscillations. At very high densities the Coulomb forces become noticeable in the stored particles and the limiting storage current restricts the power of the high-frequency system by scattering on the residual gas and by noise effects. The system is applicable for both electrons and positrons and may be used to achieve interaction of opposite beams at high energies. (TTT)

11059 RECENT DEVELOPMENTS IN LINEAR ACCELERATORS FOR THERAPY. I. THE CONTINUING EVOLUTION OF LINEAR ACCELERATORS. C. W. Miller (Associated Electrical Industries (Manchester) Ltd., Manchester, Eng.). Brit. J. Radiol., 35: 182-7(Mar. 1962).

The perspective of accelerator development is set, and some of the remaining problems are indicated. Discussion is given on the 4, 25, and 40 Mev accelerators and the klystron. The machines described are not immediately useful for clinical work, but they illustrate what can be done using klystrons. Particular attention is given to the problem of pulse shortening. Progress made in determining the cause of pulse shortening up to October 1961 is given. (P.C.H.)

11060 RECENT DEVELOPMENTS IN LINEAR ACCELERATORS FOR THERAPY. II. RECENT DEVELOPMENTS IN LINEAR ACCELERATORS AT X-BAND FOR RADIOTHERAPY. R. Beadle and M. G. Kelliher (Vickers Research Ltd., Sunninghill, Ascot, Berks, Eng.). Brit. J. Radiol., 35: 188-96(Mar. 1962).

A review is given on what is currently available in the field of supervoltage x-ray therapy machines, and recent advances in technology are critically examined to decide which, if any, of the advances may be used to improve performance, size, and cost. Discussion is given on advances on the R.F. power source, modulator and gantry, ferrite isolator, accelerator tube, and the use of magnetic amplifiers. It is concluded that the adoption of some of the numerous techniques and technological advances which have made their appearance during the past decade has resulted in a new electron linear accelerator designed specifically for x-ray therapy. The revision of design leads to a compact unit with all equipment housed either in the gantry or in the control unit. The reduction in complexity and size of such equipment is noticed not only in the basic cost but also in the cost of the building required to house the unit. (P.C.H.)

11061 RECENT DEVELOPMENTS IN LINEAR ACCELERATORS FOR THERAPY. III. MODERN TRENDS IN ACCELERATOR DESIGN FOR THERAPY. G. K. McGinty (Mullard Research Labs., Redhill, Surrey, Eng.). Brit. J. Radiol., 35: 196-9(Mar. 1962).

Discussion is given on what is termed the four essentials of a linear accelerator: a source of radiofrequency power; a structure in which electron acceleration takes place, the corrugated waveguide; an electron source or gun; and a means of producing the best possible vacuum in the waveguide. It is concluded that modern trends in accelerator design are toward a standarized machine, toward the ability of the radiotherapist to disregard details of the machine and to concentrate on its use, and toward a cheaper and more effective tool that can continually be brought within reach of more centers. (P.C.H.)

11062 NEW POWERFUL PROTON SYNCHROTRON. V. V. Vladimirskii and L. L. Gol'din. Vestnik Akad. Nauk S.S.S.R., 31: No. 1, 34-9(Nov. 1961). (In Russian)

A general review and descriptions are given of the new 7-Bev proton synchrotron operated by the Institute of Theoretical and Experimental Physics of the Academy of Sources, U.S.S.R. (R.V.J.)

11063 PARTICLE ACCELERATORS. M. Stanley Livingston and John P. Blewett. International Series in Pure and Applied Physics. New York, McGraw-Hill Book Company, Inc., 1962. 680p.

A survey is presented of the history, design, characteristics, and mathematical analyses of particle accelerators. Attention is devoted to theoretical aspects of phase stability and particle motion in electric and magnetic fields, to ion sources, to magnet design and measurement, and to shielding. The types of accelerators given particular attention include low-voltage generators, electrostatic generators, cyclotrons, betatrons, linear accelerators, synchrocyclotrons, electron and proton synchrotrons, and alternating-gradient accelerators. (T.F.H.)

Plasma Physics and Thermonuclear Processes

11064 (AD-259452) INVESTIGATION OF THE ATTENUATION OF SHOCK WAVES PROPAGATED THROUGH AN IONIZED GAS IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. Project Squid Technical Report. S. P. Carfagno and G. P. Wachtell (Franklin Inst. Labs. for Research and Development, Philadelphia). June 1961. In Cooperation with Princeton Univ., N. J. Forrestal Research Center. Contract Nonr-1858(25), NR-098-038. 89p. (FIL-1-R)

Attenuation measurements were made of shock waves propagated through ionized gas in the presence of a transverse magnetic field. Ionization was produced by maintaining a radio frequency discharge in the low pressure section of a shock tube. The electrical gas conductivity achieved by this means was less than 1 mho/m, a value much smaller than was anticipated. Largely because of the low conductivity, negligible shock wave attenuations were predicted by the pertinent theory of magnetohydrodynamics (MHD). Nonetheless, appreciable shock wave attenuations were observed. Measurements made with several experimental arrangements and statistical analysis of the data demonstrate an MHD effect. A satisfactory explanation for the apparent discrepancy between theory and experiment was not attained, although some plausible speculations were made. A discussion is presented of MHD theory and the theory of a simple shock tube in addition to a detailed discussion of the experimental measurements and an analysis of the data. (auth)

11065 (AD-259858) THEORETICAL ELASTIC COLLISION FREQUENCY BETWEEN ELECTRONS AND NEUTRAL ATOMS IN A CESIUM PLASMA. Lawrence Baylor Robinson (Aerospace Corp., El Segundo, Calif.). Mar. 22, 1961. Contract AF04(647)-594. 32p. (TDR-594(1203-01)TR-2)

The elastic scattering cross sections and momentum transfer cross sections for the collisions of low energy electrons with atomic Cs were calculated by the method of phase shifts. The scattering potential, used in the Schroedinger equation, is constructed from one electron-type wave function with appropriate screening constants. In addition to the potential arising because of the atomic electrons, a polarization potential is also used; the effect of exchange is considered only indirectly. This preliminary analysis reproduces the shape of the cross section versus energy curves as reported in some experiments but

does not give detailed agreement. The theoretical cross sections are averaged over a Boltzmann distribution of electronic energies at 1000 to 10,000°K. Averaged values of the collision (for momentum transfer) frequency between electrons and Cs atoms are also calculated. All results are presented both in graphical and tabular form. (auth)

11066 (AFCRL-339) INVESTIGATION OF NONLINEAR PHENOMENA ASSOCIATED WITH IONIZED PLASMAS. Final Report. (General Telephone and Electronics Labs. Inc., Palo Alto, Calif.). May 1, 1961. Contract AF19(604)-4083. 98p. (AD-258398)

Results are presented from an investigation concerning the nonlinear interaction of electromagnetic waves and ionized gases in the presence of d-c magnetic fields. Included are a theoretical analysis of harmonics generation in plasma layers and a discussion of higher harmonics generation. Experimental methods and results are discussed and recommendations for further work are included. (J.R.D.)

11067 (AFCRL-621) POLARIZATION OF CHARACTERISTIC WAVES IN A MAGNETO-IONIC MEDIUM. Scientific Report No. 3. G. A. Deschamps (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). Mar. 15, 1961. Contract AF-19(604)-5565. 27p. (AD-259156)

The polarization of a plane wave propagating through a homogeneous magneto-ionic medium in a given direction can be obtained from Appleton-Hartree equations. It is shown that the point representing this polarization on the Poincare sphere described simple curves when the basic parameters are varied. If these curves are drawn on a map of the Poincare sphere a convenient method results for evaluating the characteristic polarizations for any conditions in the medium or conversely for deducing the properties of the medium from the observed polarizations. Special cases are discussed in terms of this representation. (auth)

11068 (AFCRL-635) THE STABILITY OF VISCOUS FLOW BETWEEN ROTATING CYLINDERS IN THE PRESENCE OF A STRONG AXIAL MAGNETIC FIELD. Scientific Report No. 5. W. H. Reid (Brown Univ., Providence). June 1961. Contract AF19(604)-7236. 15p. (AD-259174)

Prepared for presentation at the Fourth Biennial Gas Dynamics Symposium of the American Rocket Society, to be held at the Technological Institute, Northwestern University, Evanston, Illinois.

The problem of the stability of viscous flow between rotating cylinders in the presence of an axial magnetic field is discussed within the framework of the small-gap approximation, i.e. it is assumed that d equals R2 −R1 and R2−R1 is very much smaller than $\frac{1}{2}$(R1 + R2). The nature of the problem is shown to depend very markedly on whether the cylinders rotate in the same or in opposite directions, and the various approximations applicable to these two cases are discussed. Special attention is given to the limiting case of a strong field as omega-2/omega-1 approaches minus infinity. (auth)

11069 (AFOSR-1551) ON THE DISTORTION OF A WEAK MAGNETIC FIELD BY THE FLOW OF CONDUCTING FLUID PAST A CYLINDRICAL OBSTACLE. Ko Tamada (Cornell Univ., Ithaca, N. Y. Graduate School of Aeronautical Engineering). Sept. 1961. Contract AF49(638)-674. 39p.

A study was made on the distortion of a uniform magnetic field, which is parallel to the flow at infinity, caused by the flow of an incompressible inviscid fluid with large electric conductivity past a cylindrical obstacle. The magnetic field was assumed to be so weak that its influence upon the flow may be neglected. The magnetic field outside the cylinder was found to be aligned with the flow owing to high conductivity of the fluid except in a thin layer along the surface of the cylinder and in a wake behind it. The field inside the cylinder (supposed to be non-conducting) was almost zero, except in the vicinity of the rear stagnation point where the lines of force converged and formed a singularity (sink inside and source outside the cylinder) for infinite conductivity of the fluid. (auth)

11070 (AFOSR-1864) A STUDY OF MAGNETOHYDRODYNAMIC INDUCTION DEVICES. J. M. Lyons and D. L. Turcotte (Cornell Univ., Ithaca, N. Y. Graduate School of Aeronautical Engineering). Feb. 1962. Contract AF49(638)-544. 69p.

The performance of a laminar-flow induction pump-driven by a propagating sinusoidal magnetic field is investigated. Performance estimates are made for inviscid fluids and for laminar flow of viscous fluids. It is concluded that for the strong MHD interaction that is found in typical laminar pumps, the viscous effects are limited to the laminar boundary layers near the walls while the central cores are characterized by inviscid flow and the estimated performance for the inviscid flow should be applicable to these inner cores. Similar results are expected in turbulent flow pumps. (J.R.D.)

11071 (GCA-TR-61-29-A) STEADY-STATE SHIELDING RESPONSE OF AN IRRADIATED PLASMA. 2nd Quarterly Technical Note. J. I. F. King (Geophysics Corp. of America, Boston). June 15, 1961. Contract AF-30(602)-2380. 31p. (RADC-TN-61-127; AD-259879)

For a fairly broad range of certain nondimensional parameters it is possible to couple RF power incident on an inhomogeneous plasma with the resultant beam attenuation appearing as ohmic heating of the medium. The plasma reacts to this heating with a local rise in temperature and electron density which in turn alters the pattern of heat deposition. A closed form solution was obtained for the plasma response to this heat input using the WKB solution. With an initial exponential distribution of electron density the solution predicts, after the transient response is washed out, the formation of a plasma shield in the form of a progressive invariant wave moving upstream at constant velocity toward the beam source. The shielding velocity and the shape of the wave is specified in terms of basic plasma parameters. (auth)

11072 (LMSD-894814) A STUDY OF HYDROMAGNETIC EMISSIONS. Scientific Report No. 2. Lee R. Tepley (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Apr. 14, 1961. Contract AF19(604)-5906. 77p. (AFCRL-198; AD-260280)

Considerable geomagnetic micropulsation data were collected in the interval from February to December 1960. In the discussion, however, attention is focused on the collection, reduction, analysis, and interpretation of a single useful data sample obtained during a 4-day period, November 18 to 21. To facilitate the interpretation of these data, consideration was given to observations in the same frequency range by other workers, and in particular to the observations of H. Benioff at the California Institute of Technology. These observations are discussed, and Benioff's experimental results are compared with the theoretical calculations just completed at Lockheed by W. E. Francis. The agreement between experiment and theory is consistent with the hypothesis that the signals of interest are generated above the ionosphere and are propagated downward through the ionosphere by hydromagnetic waves. The instrumentation for data collection and reduction is described. The general appearance of the signal on a

frequency-time plot (sonogram) is discussed, and the term hydromagnetic (hm) emission is defined with reference to the appearance of the signal on a frequency-time display. Of particular interest is the long duration (up to 5 hours) of some hm emissions, and the simultaneous occurrence of many emissions in groups of the same slope (time rate of change of frequency). The signals recorded at the Lockheed Magnetic Observatory are compared with signals recorded simultaneously at a number of stations of the Caltech network. Consideration is given to the relationship between the occurrence of the signals and other geophysical effects observed during the unusual period of solar and geomagnetic activity. A positive correlation is established between the occurrence of the signals and polarcap absorption. Finally, a possible analogy is drawn between hm emissions and VLF emissions as observed by other workers, and a model is presented which may lead to the understanding of generation of hm emissions. The instrumentation associated with the collection of hydromagnetic-emission data during the period February to December 1960 is described. Periods during which data were recorded are tabulated. The development of the specific instrumentation used during November 18 to 21 to obtain the data is described. Abstracts are provided of publications covering work done at Lockheed in closely related fields, and partially supported by the present contract. (auth)

11073 (NAVORD-6878) AN R. F. TECHNIQUE FOR DETERMINING THE ELECTRICAL CONDUCTIVITY OF AN IONIZED GAS IN A FLOW FIELD. T. Marshall and L. L. Hill (Naval Ordnance Lab., White Oak, Md.). July 1, 1961. 24p.

Preliminary results of a method of obtaining the electrical conductivity of a gas which is in supersonic flow are presented. These results are qualitative but indicate that a small perturbing r-f magnetic field will yield the desired conductivity measurement. (auth)

11074 (NYO-9600) MAGNETOHYDRODYNAMIC NOZZLE FLOW WITH THREE TRANSITIONS. C. K. Chu (New York Univ., New York. Courant Inst. of Mathematical Sciences). Jan. 2, 1962. Contract AT(30-1)-1480. 36p. (MF-25)

The flow of an infinitely-conducting inviscid gas in the presence of a magnetic field everywhere parallel to the velocity was considered. Such a flow starting from rest and expanding to supersonic velocities has three transitions, across each of which the flow differential equations change type: from elliptic to hyperbolic or vice versa. The flow velocities at the three transitions are, respectively, the sound speed c, the Alfven speed a, and the speed $ca/(c^2 + a^2)^{1/2}$. A class of those flows was approximately constructed by solving the flow differential equations, with the flow velocity etc., prescribed on an axis of symmetry. The solution was in the form of a formal power series in a neighborhood of the axis. The resulting streamlines gave possible symmetric nozzle contours. Some mathematical investigations were made to determine the acceptable form of the data to be given on the axis. Numerical examples giving nozzle shapes are included and compared with similar nozzles for non-conducting gases. The procedure described is an extension of that of Friedrichs for ordinary gas nozzles. (auth)

11075 (ORNL-3246) "THE PLASMA EATER:" A DEVICE TO MEASURE THE RATE OF FLOW OF A PLASMA. I. Alexeff and R. S. Neidigh (Oak Ridge National Lab., Tenn.). Feb. 19, 1962. Contract [W-7405-Eng-26]. 14p.

The "plasma eater" is a device which measures the rate of flow of a neutralized plasma. The device absorbs or "eats" the plasma entering it, and yields a current equal to the number of electrons entering the device per second. An experimental model of the device was successfully used with a mode I arc, a reflex discharge, to measure steady state plasma flow rate, ion density, and plasma decay time. (auth)

11076 (TID-14302) PARTICULATE CONTAMINATION FROM GLASS. E. E. Donaldson (Washington State Univ., Pullman). [1961]. Contract [AT(45-1)-1548]. 12p.

Thermal decomposition of glass produces spherical particles about 10^{-6} to more than 10^{-5} cm in diameter which are resistant to annealing temperatures and readily soluble in water. Because this contamination readily occurs in glass systems, it has probably produced important effects in experiments on adsorption, vacuum breakdown, and microscopy of surfaces. (auth)

11077 (UCRL-9936) HYDROMAGNETIC IONIZING WAVES. Wulf B. Kunkel and Robert A. Gross (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 26, 1961. Contract W-7405-eng-48. 43p.

[Presented at] Sixth Lockheed Symposium on Magnetohydrodynamics, Palo Alto, California, December 15-16, 1961.

One of the techniques by which highly ionized plasmas can be generated in the laboratory makes use of strong, electromagnetically driven shock waves propagating into a cold gas. If a magnetic field already exists in the undisturbed region these shocks will in general not be gasdynamic in character but the current-carrying interface will coalesce with the ionizing front. The process has certain features in common with detonation waves, and differs from previously analyzed hydromagnetic shocks in that the electric field in the undisturbed region need not vanish. If the initial magnetic field has a longitudinal component the gas must be permitted to acquire a transverse velocity. Moreover, since such shocks are almost always compressive, the plasma will usually also have a forward velocity. In closed-end tubes, therefore, the front must be followed by a rarefaction wave in which the longitudinal flow is brought to rest again. The phenomenon is analyzed as a one-dimensional single-fluid hydromagnetic problem, neglecting dissipation behind the wave. Zero conductivity is assumed for the region in front of the wave, and thermodynamic equilibrium is required behind. The problem is not determined unless an additional condition is imposed. It is hypothesized that the rarefaction wave remains attached to the front. In the limit of essentially complete ionization behind the front, the problem can be solved analytically as long as the transverse magnetic field there remains small compared with the longitudinal field. In this case the front velocity, plasma density and temperature, and the electric fields, as well as the structure of the rarefaction wave, can be expressed as simple functions of the initial magnetic field, the discharge current, the ionization energy, and the initial gas density. In this limit the compression is found to be $[\rho_2 = \rho_1(\gamma + 1)/\gamma]$, and the trailing edge of the rarefaction wave propagates at half the speed of the front. It is also possible to generate noncompressive ionizing waves, provided that the magnetic field in the undisturbed region has a transverse component that is being appropriately reduced by the driving current flowing in the ionizing front. (auth)

11078 (USCEC-79-101) RESEARCH IN PLASMA AND MAGNETOHYDRODYNAMICS. Zohrab Kaprielian (University of Southern California, Los Angeles). Dec. 1961. Contract AF49(638)-522. 22p. (AFOSR-1998)

A brief review of developments is presented in the areas of electromagnetic wave propagation in ionized media,

plasma diagnostics, electromagnetic scattering properties of plasmas, and amplification of plasma waves. (J.R.D.)

11079 (FTD-TT-61-92) THE RADIAL CONTRACTION OF LOW-PRESSURE ARCS IN MERCURY VAPOR. Albert Kloss. Translated from Elektrotech. obzor, 49: 367-72 (July 1960). 18p.

The behavior of the arc in a mercury-vapor tube was observed in relation to measurements of ion currents flowing from the arc plasma to test probes. It was found that in such tubes the arc is basically an unstable formation moving within the tube cross section and over the anode surface. It is noted that under certain conditions, a pinch effect and arc oscillations result. A discussion is included on experimental theory and procedure. (J.R.D.)

11080 (FTD-TT-62-43) THE MOTION OF A PLASMA FLOW IN A TUBE IN THE PRESENCE OF EXTERNAL INTERSECTING ELECTRICAL AND MAGNETIC FIELDS. V. M. Sarychev. Translated from Zhur. Priklad. Mekh. i Tekh. Fiz., No. 1, 3-9(Jan.–Feb. 1961). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 28257.

11081 (NSF-62-35(3)) THE MAGNETIC FIELD OF A LINEAR CURRENT WITHIN AN IDEALLY CONDUCTING CYLINDER WITH A LONGITUDINAL CUT. A translation of "Magnitnoe Pole Lineinogo Toka Vnutri Ideal'no Provodyashchego Tsilindra s Prodol'nym Razerezom." V. F. Aleksin (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 11p.

An expression was obtained for the intensity of the magnetic field of an infinite rectangular current-carrying conductor located in an ideally conducting cylindrical pipe which has a longitudinal cut. The location of the conductor and the dimensions of the cut are arbitrary. The problem of the position of the equilibrium of the conductor was solved by the method of conformal mapping. (auth)

11082 (NSF-62-35(4)) ON THE STABILITY OF A "STRATIFIED" PLASMA COLUMN. A translation of "Ob Ustoichivosti "Rassloennogo" Plazmennogo Shnura." V. F. Aleksin (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1960. 16p.

The hydrodynamic stability of a cylindrical plasma column with diamagnetic and paramagnetic axisymmetric layers of plasma was investigated. Two cases were studied: a longitudinal current flowing only in a thin surface layer, and a longitudinal current flowing both at the surface of the plasma and at the boundaries of the layers. The problem was solved in a linear approximation on the basis of the equations of ideal magnetohydrodynamics. A dispersion equation for the frequencies of the natural oscillations of the column and a stability criterion were obtained. Instabilities of the type of stretching and bending were studied in detail. (auth)

11083 BROWNIAN MOTION IN A MAGNETIC FIELD. Behram Kurşunoğlu (Atomic Energy Research Establishment, Harwell, Berks, Eng. and Univ. of Miami, Coral Gables, Fla.). Ann. Phys. (N. Y.), 17: 259-68(Feb. 1962).

It is shown that formulas for diffusion of charged particles across and along an external magnetic field can be derived as a Brownian motion of particles arising from the fluctuating electric fields of the plasma. (auth)

11084 THE DIFFUSION EQUATION WITH A QUADRATIC LOSS TERM APPLIED TO ELECTRON-ION VOLUME RECOMBINATION IN A PLASMA. Ernest P. Gray (Johns Hopkins Univ., Silver Spring, Md.) and Donald E. Kerr. Ann. Phys. (N. Y.), 17: 276-300(Feb. 1962).

The diffusion equation for charged particles in a plasma, with an additional recombination loss term (quadratic in the particle concentration n) was solved numerically for plasmas in containers having the shape of an infinite cylinder and a sphere. This equation applies to a decaying plasma in thermal equilibrium, with no sources of ionization, no loss mechanisms other than diffusion and volume recombination, and containing no negative and only one species of positive ion. The boundary condition $n_{wall} = 0$ and the initial conditions of uniform concentration and of the lowest diffusion mode were used. For a given choice of these conditions, each solution is uniquely specified by a single parameter β, the ratio of the initial central particle loss rate which would prevail in the absence of diffusion, to the corresponding loss rate resulting from only diffusion in the fundamental mode. It is a quantitative measure of the degree of recombination control. These solutions were used to assess the limits of applicability and the accuracy of the microwave cavity method for determining the recombination coefficient α as the slope of a plot of the reciprocal of the measured electron concentration vs. time. It is found that a linear region in this plot can exist for $\beta = 0$, and that the slope is unrelated to α for sufficiently small β. Only if β is very large, and if the linear region is sufficiently extended, does the slope constitute a reasonable approximation to α. A criterion is established for the validity of this method of determining α, and is applied to previous experiments. It is found that although some experiments satisfy this criterion and presumably yield good values of α, others do not and yield values that are too large. (auth)

11085 PLASMA THERMODYNAMICS. I. PROPERTIES OF HYDROGEN, HELIUM, AND LITHIUM AS PURE ELEMENTAL PLASMAS. Henry A. McGee, Jr. (Georgia Inst. of Tech., Atlanta) and Gerhard Heller. ARS (Am. Rocket Soc.) J., 32: 203-15(Feb. 1962).

The problem of computing the thermodynamic properties of a plasma composed of atoms, atomic ions, and electrons is examined from an initially rigorous point of view. Sufficient detail of the subsequent approximations that are required to develop a tractable physical model are presented to indicate the major problem areas and the optimum approximations that permit a solution of the problem. For each of the three elements considered, tables are presented for the thermodynamic excess functions that were evaluated by considering the plasma to be a Debye-Hückel ionic solution. Tables are also presented to show the effect of the Debye-Hückel nonideality on the equilibrium ionization. Thermodynamic property tables for these species were computed using a minimization of free energy technique which is also briefly described. These data and comparisons encompass the range 2000 to 50000°K and 100 to 0.0001 atm. (auth)

11086 SOME PROBLEMS OF L-F WAVE PROPAGATION IN A PINCHED VISCOUS PLASMA ALONG A MAGNETIC FIELD. E. A. Ponomarev. Astron. Zhur., 38: 877-84(Sept.-Oct. 1961).

In a study of the fading and interaction of various types of oscillations related to the heating of the solar corona, the theory of magnetohydrodynamic corona heating is considered the only acceptable theory. This theory can be brought into agreement with observational results by systematically taking into account the effect of viscosity. This possibility is illustrated by the consideration of a plane wave propagating in the direction of a magnetic field in a pinched viscous plasma and having an amplitude lower than the magnetic-field intensity. The fluctuation of the

plasma density is considered to be lower than the density fluctuation of unperturbed plasma, and the effects of radiation and heat conductivity are agnored. Relationships generalizing the known magnetohydrodynamic equations are derived and the following conclusions reached: 1) in a pinched viscous plasma the following waves may propagate along the magnetic field, depending on $V_0^2/\omega\vartheta$ where V_0 and ω are the wave velocity and wave frequency, respectively, and $\vartheta = c^2/4\pi\sigma + \nu$ (σ is the plasma conductivity and ν the viscosity): magnetohydrodynamic and sound waves if $V_0^2/\omega\vartheta > 1$; and viscous, sound, and radio waves if $V_0^2/\omega\vartheta < 1$; 2) in relation to a magnetohydrodynamic wave, viscous plasma is a dispersing medium; 3) at $V_0^2/\omega\vartheta > 1$ the attenuation is $\delta = (\omega^2\vartheta)/(2V_0^3)\ [1-(c2V\omega^2)/(2\pi\sigma V_0^4)]$; 4) the attenuation of magnetohydrodynamic waves in plasma cannot be of unlimited low value and the concept of undamped waves cannot be regarded as correct when applied to solar conditions; 5) magnetohydrodynamic waves cause the appearance of strongly damped longitudinal waves which, under certain conditions, dissipate a considerable amount of energy; and 6) in high-conductivity plasma, the depth of penetration of viscous waves may exceed considerably the depth of penetration of electromagnetic waves, although the former carry only an insignificant amount of energy. (AID)

11087 PARTICULAR CYLINDRICAL WAVES OF MAGNETOHYDRODYNAMICS. Giovanni Crupi (Università, Messina, Italy). Atti seminar. mat. e fis. univ. Modena, 10: 1-10(1960-61). (In Italian)

In an incompressible fluid with finite electrical conductivity, particular cylindrical waves were considered on the basis of the Euler-Minkowski approximation system, emphasizing the contribution obtained from not neglecting the displacement current. After having reduced the problem to a single equation of the partial derivative of the fourth order, a complete calculation of a particular solution was obtained. (tr-auth)

11088 PARTICULAR ALTERNATING FIELDS IN THE MAGNETODYNAMICS OF A VISCOUS FLUID. Renato Nardini (Università, Modena, Italy). Atti. seminar. mat. e fis. univ. Modena, 10: 145-57(1960-61). (In Italian)

A homogeneous incompressible fluid with definite viscosity and with electric conductivity great enough to be considered infinite is considered in the presence of a magnetic field. Plane solutions are obtained for the equations which control its behavior with respect to the displacement current and the density of the spatial electric charge. After the corresponding scalar equations are derived, a solution of the sinusoidal type is calculated. Some energy relationships are then derived. The mean energy velocity and the group velocity are calculated. (J.S.R.)

11089 THE THEOREM OF UNIQUENESS FOR THE MAGNETODYNAMIC EQUATIONS OF A COMPRESSIBLE FLUID IN AN UNLIMITED REGION. Italo Ferrari (Università, Modena, Italy). Atti seminar. mat. e fis. univ. Modena, 10: 158-74(1960-61). (In Italian)

The uniqueness theorem for magnetodynamic equations of compressible fluids previously derived (Atti Sem. Mat. Fis. Univ. Modena 9, 205(1960)) is generalized. Only the effects of the density of spatial electric charge are ignored. It is assumed that the fluid, contained in an unlimited region, is compressible and has variable temperature and that it is homogeneous, viscous, and electrically conductive. Consideration was given to the energy dissipated by viscosity and by the Joule effect. (J.S.R.)

11090 EFFECT OF CORRELATIONS ON THE TRANSPORT COEFFICIENTS OF A PLASMA. R. Balescu and Ph. de Gottal (Université Libre, Brussels). Bull. classe sci., Acad. roy. Belg., (5), 47: 245-58(1961). (In French)

A closed formula is obtained for the long-lived correlations in an inhomogeneous plasma; it is expressed in terms of the one particle distribution function. This forms an appropriate starting point for a rigorous theory of transport phenomena in plasmas, including the effect of molecular correlations. An expression is obtained for the thermal conductivity. (auth)

11091 PHOTOELECTRIC STUDY OF A MAGNETIC SHOCK TUBE CONTAINING TWO GASES. Michel Cloupeau. Compt. rend., 254: 213-15(Jan. 8, 1962). (In French)

The formation of shock fronts and plasma discharges, and the light emission at several frequencies are studied in a shock tube in which the initial configuration consists of two gases that are almost completely separated. The time-resolved light emission intensity is used to determine the spatial relationships between the shock front and plasma front. (T.F.H.)

11092 THE STARTUP OF MOTION IN AN ELECTRICALLY CONDUCTING LIQUID, CONFINED BETWEEN INFINITE PARALLEL PLANES AND SUBJECTED TO A TRANSVERSE MAGNETIC FIELD. Étienne Crausse, René Causse, and Yves Poirier (Laboratoire de Physique Industrielle, Faculté des Sciences, Algiers). Compt. rend., 254: 216-18(Jan. 8, 1962). (In French)

A theoretical study is made of the startup of motion in a viscous, electrically conducting liquid in the presence of a magnetic field perpendicular to the plane in which the liquid is confined. The fundamental parameters of the motion are studied, and theoretical curves for some values of these parameters are given. (tr-auth)

11093 EXPERIMENTAL STUDIES OF THE FREE OSCILLATIONS OF A HEAVY, VISCOUS, ELECTRICALLY CONDUCTING LIQUID, IN A U-SHAPED TUBE IN A MAGNETIC FIELD. René Causse, Yves Poirier, and Charles Vivés (Laboratoire de Physique Industrielle, Faculte des Sciences, Algiers). Compt. rend., 254: 423-5(Jan. 15, 1962). (In French)

It is found that the relative elongation of the free surface does not depend, at least practically, on the Hartmann number, or on the parameter $(R^2/\nu)(g/l)^{1/2}$. R is the tube radius, ν the frequency, and 2l the length occupied by the liquid (Hg) in the tube. (T.F.H.)

11094 SCATTERING OF ELECTROMAGNETIC WAVES BY PERTURBATIONS IN A PLASMA. Ya. L. Al'pert and L. P. Pitaevskii. Geomagnetizm i Aeronomiya, 1: 709-24 (Sept.-Oct. 1961).

A theoretical analysis was made of the effective scattering cross section of electromagnetic waves from the trail of a body moving rapidly through a magnetized plasma. The formulas used (developed previously by L. P. Pitayevskiy) take into account the effect of the magnetic field, the number of ion collisions, the size of the body (especially those smaller than the wavelength), and to some extent the electrical field in the vicinity of the body. From the results, quantitative and qualitative concepts are formed of the nature of the scattering effect in a rarefied plasma (particularly in the ionosphere) for the case when the length of the particle path considerably exceeds the dimensions of a body moving at a velocity greater than the thermal velocity of ions and considerably lower than that of electrons. The cross section of scattering is shown to be a sharply directed multilobe function whose maximum lies in the direction of the image reflection of the wave from the vector of the permanent magnetic field. The

nature of the scattering is found to be a function of the velocity and linear dimensions of the body, and depends only slightly on its properties, shape, and surface. (OTS)

11095 THE STRUCTURE OF A HYDROMAGNETIC FRONT IN A COLD COLLISION-FREE PLASMA. P. G. Saffman (King's Coll., London). J. Fluid Mech., 12: 81-7 (Jan. 1962).

A one-dimensional steady solution of the equations of motion of a cold plasma in a magnetic field is obtained. The plasma is of semi-infinite extent, bounded by a plane interface which separates it from a vacuum or medium at rest. The particles approach from infinity, are reflected at the front, and return to infinity in the opposite direction. At infinity, the magnetic field is parallel and anti-parallel to the plasma streams, and is inclined at an angle to the normal to the interface. The front is a current sheet across which the lines of force are bent, with the component of the magnetic field in the plane of the front changing direction. The inertia of the electrons is neglected, and the characteristic frequency associated with the front is the ion gyro-frequency. (auth)

11096 COMPUTATION OF THE BOUNDING SURFACE OF A DIPOLE FIELD IN A PLASMA BY A MOMENT TECHNIQUE. James E. Midgley and Leverett Davis, Jr. (California Inst. of Tech., Pasadena). J. Geophys. Research, 67: 499-504(Feb. 1962).

The cavity formed by a plasma-free dipole magnetic field in a field-free stationary plasma is determined by a numerical method. The shape of the cavity is found by requiring that each multipole moment of the surface currents just cancel the corresponding moment due to the source of the field. For a dipole source of moment M in a plasma whose pressure is p, there is a cusp of the polar axis at 0.64 times the equatorial radius, which is $0.82615M^{\frac{1}{3}}p^{-\frac{1}{6}}$. The relative accuracy of Beard's approximate method of solution is examined and found to be poor. A way is given in which the moment method might be used to obtain the shape of the cavity produced in the solar wind by the earth's magnetic field. (auth)

11097 ANALYSIS OF PROBE CHARACTERISTICS IN DRIFTING PLASMA. Toshihiko Dote, Kazuo Takayama, and Tarao Ichimiya (Nippon Telegraph and Telephone Public Corp., Tokyo). J. Phys. Soc. Japan, 17: 174-83 (Jan. 1962). (In English)

A method to calculate the altitude profiles of positive ion density in the ionosphere from the ion current obtained by a rocket-borne Langmuir probe is proposed. For a spherical probe, moving relatively to a plasma, the form of the ion sheath is deformed from the spherical one. It is assumed that the radius of the ion sheath perpendicular to the moving direction is equal to that of the probe at rest; for the forward sheath a rotating ellipsoid is applied, and in the backward the ordinary relation between the total current and the current density at the surface of sheath is used. Positive ion densities of the ionosphere are determined by using the above relations and observed total current. Agreement of the calculated values with the simultaneous observations of the electron density at E-layer from h'-f curves indicates the validity of the method. (auth)

11098 FORMATION OF LOCALIZED PLASMAS IN PULSED MICROWAVE DISCHARGE. Shuji Fukui (Nagoya Univ., Japan), Satio Hayakawa, Hideo Nukushina, and Takashige Tsukishima. J. Phys. Soc. Japan, 17: 250-1(Jan. 1962). (In English)

Discharge characteristics in Ne-Ar mixtures were studied. The Penning effect is discussed. At low field strengths, most of the electrons were produced by interactions of metastable Ne atoms with Ar atoms. This process was too slow to account for the fast discharge buildup observed. At high field strengths, electron energies were so high that direct ionization became more effective. When the proportion of Ar was further increased, electron mean energy decreased; the electron mean free path is much shorter in Ar than in Ne. Electron energy distributions were considered as functions of E/P. A plot of breakdown field strength versus Ar content is presented. (L.N.N.)

11099 ELECTRICAL BREAKDOWN IN A SHOCKED GAS. P. B. Barber, C. S. Gaskell, J. S. T. Looms, D. A. Swift, and B. A. Tozer (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). Nature, 193: 563-4(Feb. 10, 1962).

An impulse electrical breakdown in a plasma homopolar discharge tube was observed in air and argon at 400 μ to to 4 mm Hg pressures. When a capacitor bank having a current period of 30 μsec is connected between the electrodes, the initial discharge occurs along a radial path from which a pair of shock waves diverges. Breakdown follows the shocks, the whole region becoming luminous except for a space in which the shocks collide. The dark space is stable for some tens of μsec, and multiple initial discharges give multiple dark spaces. (D.L.C.)

11100 ON THE DIFFUSION OF AN ELECTRIC FIELD IN A COLLISIONLESS PLASMA. F. Engelmann, M. Feix, E. Minardi, and J. Oxenius (Association Euratom-C.E.A., Fontenay-aux-Roses, France). Nuovo cimento (10), 22: 1012-22(Dec. 1, 1961). (In English)

Using the linearized Vlasov equation, the propagation of an electric field in a one-dimensional collisionless plasma is studied. A temporally and spatially localized perturbation is used as an experimentally realizable initial condition. The asymptotic behavior for large times of the excited electric field is independent of the special velocity distribution function. This may give rise to Landau damping. Around the perturbation center, however, a zone whose size increases as $t^{\frac{1}{2}}$ is established in which the amplitude of the electric field, oscillating with plasma frequency, is spatially almost constant and decreases in time as $t^{-\frac{1}{2}}$, thus showing essential characteristics of a diffusion process. (auth)

11101 ELECTRON-ION RECOMBINATION IN DENSE PLASMAS. Einar Hinnov and Joseph G. Hirschberg (Princeton Univ., N. J.). Phys. Rev., 125: 795-801(Feb. 1, 1962). (MATT-93)

The rate of recombination and the characteristics of the afterglow line emission were measured in magnetically confined plasmas of helium and hydrogen, with electron densities of the order of 10^{13} cm^{-3} and degree of ionization initially of the order of 50%. Electron densities and temperatures are deduced from absolute intensity measurements of spectrum line intensities originating from highly excited states, in good agreement with those obtained from microwave phase shift and plasma conductivity measurements. Results are explained in terms of an electron-electron-ion three-body recombination process. The recombination coefficient for this process is calculated as a function of electron temperature and density. (auth)

11102 APPROACH TO EQUILIBRIUM OF ELECTRONS, PLASMONS, AND PHONONS IN QUANTUM AND CLASSICAL PLASMAS. David Pines and J. Robert Schrieffer (Univ. of Illinois, Urbana). Phys. Rev., 125: 804-12 (Feb. 1, 1962).

The approach to equilibrium of electrons, plasmons, and phonons in finite-temperature plasmas is studied in the

random phase approximation. It is first shown that for an electron plasma in equilibrium, the long-wavelength, well-defined, plasmons contribute a term to the free energy which is appropriate to a collection of independent bosons. To study nonequilibrium processes, an explicit plasmon distribution function is introduced. The matrix element for plasmon-electron coupling is calculated in the random phase approximation, and second-order perturbation theory is used to derive equations which coupling the electron and plasmon distribution functions. Equilibrium results from the competition between the spontaneous emission of plasma waves by single fast electrons and the Landau damping of the plasma waves due to the same group of particles. The equation for the time rate of change of the electron distribution function reduces, in the classical limit, to a Fokker-Planck equation in which there appear diffusion and friction terms associated with plasma waves, of the type first considered by Klimontovitch (Y. Klimontovitch and V. P. Salin, Soviet Phys.-Uspekhi 3: 84(1960)). When an initial arbitrary nonequilibrium electron distribution is considered, it is seen that a plasma wave instability corresponds to coherent excitation of plasma waves by the electrons in contrast to the incoherent excitation associated with spontaneous emission. The method is generalized to two-component electron-ion plasmas in which well defined acoustic plasma waves exist, by introducing an explicit distribution function for the phonons (the acoustic plasmons). The approach to equilibrium and the two-stream instability are derived and discussed for the coupled electron-phonon system; results similar to those obtained for the electron-plasmon system are found. (auth)

11103 DEMONSTRATION OF CLASSICAL PLASMA BEHAVIOR IN A TRANSVERSE MAGNETIC FIELD. D. A. Baker and J. E. Hammel (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 8: 157-8(Feb. 15, 1962).

Properties of a low-β plasma streaming transverse to a magnetic field were examined. The motion of the plasma was stopped when its internal field was removed. A conducting liner was used in the vacuum chamber. (L.N.N.)

11104 MAGNETIC FIELDS IN ROTATING PLASMAS UNDER QUASI-STATIONARY CONDITIONS. H. P. Baginski and W. Lochte-Holtgreven (Universität, Kiel). Z. Naturforsch., 16a: 960-72(Oct. 1961). (In German)

A rotating thermal plasma of low ionization degree was produced by an oxyhydrogen flame with potassium–sodium additions. The research conditions were selected so that the electrons and ions possess a small macroscopic initial velocity with respect to the neutral particles. Consequently, the charge carrier components were accelerated by collision with the neutral particles with variable intensity. The electrical circular current originating therefore produces magnetic fields which were experimentally detected and interpreted theoretically. (tr-auth)

11105 PROPAGATION OF ELECTROMAGNETIC WAVES IN PLASMA. V. L. Ginzburg. Russian Monographs and Texts on Advanced Mathematics and Physics. Volume VI. New York, Gordon and Breach, Science Publishers, Inc., 1961. 844p. $12.50. Translated by Royer and Roger from "Rasprostraneniye Elektromagnitnykh Voln v Plazme." Moscow, Fizmatgiz, 1960.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 3654.

11106 APPARATUS FOR CONFINING A PLASMA. Bo Peter Lehnert and Bjorn Karl Johan Bonnevier. British Patent 889,234. Feb. 14, 1962.

An apparatus is designed for confining a plasma in a thermonuclear reactor so that all of the volume between the two confining surfaces is utilized as the reaction space while preventing loss of plasma particles by collision with the wall. The plasma is confined by two toroidal surfaces generated by a magnetic field surrounding an annular electrical conductor and is caused to rotate around the symmetry axis of the apparatus by an electric field generated between two electrodes located in the toroidal surfaces. (D.L.C.)

11107 IMPROVED PINCHED PLASMA REACTOR. (to U. S. Atomic Energy Commission). British Patent 889,465. Feb. 14, 1962.

The theory of thermonuclear reactions and the pinch effect is discussed at some length. A toroidal thermonuclear reactor is designed which prevents contamination of the pinched plasma by the wall and stabilizes the pinched plasma. An internal winding is provided which creates a field component in a direction opposite to that of the axial magnetic field within the plasma, thereby producing a large shear in the magnetic field and stabilizing the pinched plasma. (D.L.C.)

11108 IMPROVED PROCESS AND APPARATUS FOR PRODUCING ENERGY BY NUCLEAR FUSION. Jiri George Linhart. British Patent 889,890. Feb. 21, 1962.

A cylindrical thermonuclear reactor is designed in which deuterium and/or tritium gases are introduced through orifices in the curved wall and an electrical discharge is applied between the ends. The advantage of this reactor is that the discharge is produced at a very high temperature. (D.L.C.)

11109 PLASMA ENERGIZATION. Harold P. Furth and Edmund S. Chambers (to U. S. Atomic Energy Commission). U. S. Patent 3,024,182. Mar. 6, 1962.

A method is given for ion cyclotron resonance heating of a magnetically confined plasma by an applied radio-frequency field. In accordance with the invention, the radio-frequency energy is transferred to the plasma without the usual attendent self-shielding effect of plasma polarization, whereby the energy transfer is accomplished with superior efficiency. More explicitly, the invention includes means for applying a radio-frequency electric field radially to an end of a plasma column confined in a magnetic mirror field configuration. The radio-frequency field propagates hydromagnetic waves axially through the column with the waves diminishing in an intermediate region of the column at ion cyclotron resonance with the field frequency. In such region the wave energy is converted by viscous damping to rotational energy of the plasma ions. (AEC)

11110 ION MAGNETRON. James Donald Gow and R. W. Layman (to U. S. Atomic Energy Commission). U. S. Patent 3,025,429.

A magnetohydrodynamic device or plasma generator of the ion magnetron class is described wherein a long central electrode is disposed along the axis of an evacuated cylinder. A radial electric field and an axial magnetic field are provided between the cylinder and the electrode, forming a plasma trapping and heating region. For maximum effectiveness, neutral particles from the cylinder wall must be prevented from entering such region. This is effected by forming a cylindrical sheath of electrons near the cylinder wall for ionizing undesired neutral particles, which are then trapped and removed by the magnetic field. An annular filament at one end of the device provides the electrons, which follow the axial magnetic field to a reflecting electrode at the opposite end of the device. (AEC)

Shielding

Refer also to abstracts 11306 and 11307

11111 (AD-259663) THE SPLIT SCATTER SHIELD FOR SPACE APPLICATIONS (thesis). John O. Berga (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Mar. 1961. 54p. (GNE/Phys/61-2).

The split scatter shield consists of multiple shield sections which are separated from each other. When this type of shield is used outside the atmosphere, radiation scattering in each section has a high probability of escaping the shield system without rescattering. Consequently, this shield was proposed as a replacement for the normal shield unit construction for space applications. The split shield was compared with a unit shield of the same weight and material in a hypothetical problem situation by computing the radiation attenuation by each. The problem was computed using point and circular source geometries assuming the sources to emit gamma rays only. The calculations were performed using simplifying assumptions so that computer programs were not necessary. A geometrical parameter study was performed for the split shield to determine the optimum number of sections, the optimum separation distance between sections, and the maximum flux attenuation. The results indicated that a split shield is capable of greater flux attenuation by a factor of more than four than a unit shield of the same weight. (auth)

11112 (DC-55-6-55) COMPUTER PROCEDURE FOR DETERMINATION OF ATTENUATION OF FISSION PRODUCT GAMMA RAYS THROUGH LEAD. A. J. Ness (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 3, 1955. Contract AT(11-1)-171. 39p.

A detailed program for use on the IBM 604 computer is presented to calculate dose rate values for gamma ray energy levels, shield thicknesses, and operating periods of reactor power. These were the first calculations made with the recently added features of program repeat and zero test. (auth)

11113 (DC 57-8-83) RATIOS OF COMPTON SCATTERING AND TOTAL ATTENUATION COEFFICIENTS. M. A. Capo (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 9, 1957. Contract AT(11-1)-171. 7p.

Tables of the ratio of Compton scattering to total attenuation coefficients for H_2O, Al, Fe, Pb, W, and U at various gamma ray energy levels are presented. These ratios are utilized as input data for Shielding Programs 04-2 and 12-0 which compute gamma ray dose rates. (auth)

11114 (DC 57-8-158) POLYNOMIAL APPROXIMATION OF LINEAR GAMMA RAY ABSORPTION COEFFICIENTS. M. A. Capo (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 19, 1957. Contract AT(11-1)-171. 11p.

Polynomial coefficients fitted by least squares method to approximate linear gamma ray total absorption coefficients (both including and excluding coherent scattering) are presented over several energy ranges. Materials investigated were air, water, lead, aluminum, lithium hydride, and polyethylene. The polynomial coefficients tabulated here are used in Shielding Computer Programs 05-0 and 07-1. Per cent deviations of the approximated values of the absorption coefficients are included. (auth)

11115 (DC-57-10-46) ANALYSIS OF 2π EXPERIMENTS, MILESTONE I–TASK 7711. L. S. Burns. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sep. 30, 1957. Contract AT(11-1)-171. 104p.

An analysis is presented of the experiments performed at the ORNL Tower Shielding Facility during the months of September through December, 1956 in which 2π covers were placed on the reactor shield and crew shield of a shield system. The analysis covers radiation penetrating the reactor shield, radiation penetrating the crew shield and the effects of 2π covers. Results of the analysis are compared with the data. Some of the analytical method details are included. Conclusions are drawn from the effects of the 2π covers. (auth)

11116 (DC-57-11-77) DESCRIPTION OF ANPD SHIELDING COMPUTER PROGRAMS. M. A. Capo (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 29, 1957. Contract AT(11-1)-171. 31p.

The available ANPD shielding analysis programs written for IBM digital computers are described. Each description includes: the purpose of the program, the various theoretical or physical assumptions, and the major computer components required by the program. (auth)

11117 (DC-57-11-101) SHIELDING COMPUTER PROGRAM 04-2, REACTOR SHIELD ANALYSIS. W. E. Edwards, J. E. MacDonald, and J. J. Loechler (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 18, 1957. Contract AT(11-1)-171. 91p.

Shielding Computer Program 04-2 is available for computing reactor-shield weight and fast neutron and gamma ray dose rates in and around complex reactor-shield assemblies. Reactor and shield geometries are described by combinations of regions formed by rotating rectangles or trapezoids about the reactor axis or by translating rectangles parallel to the reactor axis. Compositions are expressed as volume fractions for each material in the reactor-shield assembly. A cylindrical coordinate system is used to describe the location and dimensions of volume, surface, line, or point sources. Source distributions are assumed separable and may be described by either cosine or exponential functions. A modification of the Albert-Welton theory of neutron attenuation is used for fast neutron dose rate calculations. Combination of buildup factors by empirical expressions is used with exponential attenuation to compute gamma ray dose rates. The program requires two magnetic tape units and eight frames of magnetic core memory on an IBM-704. Magnetic drum memory is not required. (auth)

11118 (DC-57-11-103) SOURCE FUNCTION COEFFICIENT EVALUATION. Mary Ann Capo (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 14, 1957. Contract AT(11-1)-171. 8p.

Expressions are presented for evaluating one of the coefficients used in the functions describing the source distribution in a cylindrical volume source. Such functions are part of Shielding Computer Program 04-2. (auth)

11119 (DC-58-4-121) SHIELDING COMPUTER PROGRAM 04-1, REACTOR SHIELD ANALYSIS. W. E. Edwards, M. A. Capo, and K. Paine (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 11, 1958. Contract AT(11-1)-171. 83p.

Shielding Computer Program 04-1 is available for computing reactor-shield weight and fast neutron and gamma ray dose rates in and around complex reactor-shield assemblies. Reactor and shield geometries are described by combinations of regions formed by rotating rectangles or trapezoids about the reactor axis or by translating rectangles parallel to the reactor axis. Compositions are expressed as volume fractions for each material in the reactor-shield assembly. A rectangular coordinate system is used to describe the location and dimensions of

volume, surface, line, or point sources. Source densities are described by tables containing values for each of the source region nodal points. A modification of the Albert-Welton theory of neutron attenuation is used for fast neutron dose rate calculations. Combination of buildup factors by empirical expressions is used with exponential attenuation to compute gamma ray dose rates. The program uses two magnetic tape units and eight frames of magnetic core memory on an IBM-704. Magnetic drum memory is not required. (auth)

11120 (DC 58-5-132) SHIELDING COMPUTER PROGRAM 14-0, REACTOR SHIELD ANALYSIS. J. T. Martin, J. P. Yalch, and W. E. Edwards (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 19, 1958. Contract AT(11-1)-171. 138p.

Shielding Computer Program 14-0 evaluates point-to-point attenuation functions and integrates over source regions to perform reactor-shield penetration calculations for neutrons and gamma rays. Neutron dose rates and gamma ray flux and dose and energy absorption rates can be computed for positions in and around complex reactor shields containing multiple sources described in a cylindrical coordinate system. In addition, the program can compute reactor-shield weight. Computation of any or all of these quantities in a single problem is optional. Enough physical and source description capability is provided by the program that nuclear analysis of reactor-shield assemblies currently considered at ANPD should involve little uncertainty except that associated with point-to-point attenuation functions and secondary source distributions. A modification of the Albert-Welton theory of neutron attenuation is used for fast neutron dose rate calculations. Combination of buildup factors by empirical expressions is used with exponential attenuation to compute gamma ray dose rates. The program is coded for use on an IBM-704 having 32,768 magnetic core memory locations. Magnetic tape units are used for the production package and output. No magnetic drum memory is required. (auth)

11121 (DC-59-8-37) MONTE CARLO RESEARCH SERIES: PRE-SAMPLED ENERGY DEPOSITION METHOD FOR GAMMA HEATING CALCULATIONS. J. R. Beeler, M. D. McDonald and J. F. Quinlan (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 1959. Contract AT(11-1)-171. 14p.

A simplified method for Monte Carlo gamma heating computation is described. This method uses pre-sampled energy deposition data rather than energy deposition values which are generated during computation. The method is restricted to systems with a maximum of twenty regions. (auth)

11122 (DC-59-12-229) SUMMARY REPORT OF GAMMA RAY POINT SOURCE DATA FROM SINGLE MATERIAL MEASUREMENTS (MILESTONE I, JOB 51292, TASK 431321). V. J. Mitchell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 31, 1959. Contract AT(11-1)-171. 66p.

Data from Gamma Ray Point Source experiments with water, Al, Fe, Pb, hevimet, and U using Cs^{137} and Co^{60} sources are presented graphically and in tabular form. Pertinent calibration data (both count rate and spectrographic) are also included. (auth)

11123 (DC 60-4-108) SUMMARY REPORT OF GAMMA RAY POINT SOURCE DATA FROM MULTIPLE MATERIAL MEASUREMENTS (MILESTONE III, JOB 51292, TASK 431321). V. J. Mitchell (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 18, 1960. Contract AT(11-1)-171. 163p.

Data from gamma ray point source experiments with two and three material layer combinations of water with aluminum, iron, lead, hevimet, and uranium using Co^{60} and Cs^{137} sources are presented graphically and in tabular form. Pertinent calibration count rate data are also presented. (auth)

11124 (GEMP-102) SPECIALIZED REACTOR-SHIELD, MONTE CARLO PROGRAM 18-0. J. E. MacDonald, J. T. Martin, and J. P. Yalch (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Oct. 1961. Contract AT(40-1)-2847. 122p.

Supersedes TID-11681; (XDC-61-1-91).

A digital computer program that applies Monte Carlo methods to simulate neutron and gamma ray life histories in reactor-shield assemblies is described. The code is specialized to provide only as much geometry and importance sampling capabilities as are needed for analysis of GE-ANPD reactor-shield systems. Specialization in these areas results in a more efficient code for analysis of reactor-shield systems than can be achieved by application of more general purpose Monte Carlo codes. The program is coded for an IBM-7090 with a fast memory capacity of 32,768 storage locations. Seven magnetic tape units are required, but no magnetic drum storage is necessary. (auth)

11125 (TID-14558) CURRENT OUTSTANDING SHIELDING PROBLEMS. R. Aronson, E. P. Blizard, F. H. Clark, H. Goldstein, M. Grotenhuis, W. G. Kreger, F. C. Maienschein, F. W. Mezger, P. Mittelman, N. M. Schaeffer, L. V. Spencer, M. F. Valerino, and H. C. Woodsum (Division of Reactor Development, AEC). Mar. 1962. 20p.

A listing and discussion of the following outstanding shielding problems are presented: microscopic neutron cross-section data, attenuation in simple geometries, attenuation in ducts, secondary gamma radiation protection, shielding against high-energy radiations, energy deposition by radiation, shielding instrumentation, and development of Monte Carlo techniques. (M.C.G.)

11126 PASSAGE OF GAMMA-RADIATION THROUGH HETEROGENEOUS MEDIA. D. L. Broder, Yu. P. Kayurin, and A. A. Kutuzov. Atomnaya Energ., 12: 30-5(Jan. 1962). (In Russian)

Although the buildup factor (which depends primarily on the original energy of the γ-radiation, the thickness of the material and its atomic number) can be conveniently determined for a large number of homogeneous media, its measurement in systems consisting of alternating layers of different materials requires further study. The problem was examined by means of a 1.25-Mev Co^{60} point source for shields consisting of various assemblies of polyethylene, Al, Fe, and Pb. Results showed that the currently used formulas yield erroneous results concerning the magnitude of the dose beyond a shield at a relatively large distance from the point source. An empirical formula was derived for calculating the buildup factor of any heterogeneous system for which the factors of the individual components are known. Experimental determinations showed that the buildup factors of shields with thicknesses ranging from 0.7 to 15 mean free paths did not differ by more than 10% from the values calculated with the help of this formula. As the buildup factor changes uniformly with increasing energy up to the point at which the attenuation coefficient of the material reaches a minimum, it may be safely assumed that the formula is applicable for energies higher than 1 Mev at which it was tested. (TTT)

11127 TABLES FOR CALCULATING THE THICKNESS OF LEAD GLASS SHIELDING FOR PROTECTION

AGAINST BROAD BEAMS OF γ RADIATION. L. M. Mikhailov and Z. S. Aref'eva. Atomnaya Energ., 12: 58-62(Jan. 1962). (In Russian)

The shielding properties of three lead glasses with densities of 3.86, 4.77, and 6.73 g/cm^3 were calculated, tabulating thickness vs. attenuation of the broad beam of γ radiation at various energies. The buildup factors needed in the calculations were determined on the basis of G. Gol'dshteĭn's method (Principles of Reactor Shielding, Gosatomizdat, 1961). The accuracy of the calculations is 5 to 6% for the 3-Mev γ-ray quanta and varies between 6 and 20% for the 10-Mev radiation. (TTT)

Theoretical Physics

11128 CONTRIBUTION TO THE STUDY OF NON-RELATIVISTIC DISPERSION FORMULAS. Rene Ceuleneer. Bull. classe sci., Acad. roy. Belg., (5) 47: 406-26 (1961). (In French)

The influence of a cut-off on a central potential was studied by means of the poles of the scattering matrix S(k). The poles which are practically independent of this cut-off are called stable. It is proven that these poles are contained in the analyticity strip of S(k). A dispersion relation for which the resonant terms and the potential scattering term are stable is constructed. (auth)

11129 MUONIC CHARGE AND NEW GENERAL GAUGE TRANSFORMATION. Kuo-Hsien Tzou. Compt. rend., 254: 228-30(Jan. 8, 1962). (In French)

The general form of the gauge invariance of the field of a mass doublet is studied. The "muonic charge" gauge is introduced, which gauge permits the avoidance of difficulties arising in the use of a particular field C_λ. The selection rules under C_λ are unchanged by the muonic charge gauge. (tr-auth)

11130 ON THE INTERPRETATION OF QUANTUM MECHANICS. THE CASE OF NONRELATIVISTIC PARTICLE WITH SPIN. Assène Datzeff. Compt. rend., 254: 434-6(Jan. 15, 1962). (In French)

For a nonrelativistic particle with spin (e.g. an electron) in a magnetic field, the continuity equations, probability functions, and spin matrices are derived. (T.F.H.)

11131 ON THE REDUCTION OF MANY ELECTRON PROBLEMS BY PERTURBATION THEORY. Oktay Sinanoğlu (Yale Univ., New Haven). J. Chem. Phys., 36: 564-5(Jan. 15, 1962).

It was previously shown (Phys. Rev. 122: 493 (1961) and Proc. Roy. Soc. (London) A260: 376 (1961)) how correlation effects in atoms and molecules can be treated in perturbation theory by rigorously reducing the N-electron problem into several He or H_2-like problems. It was indicated that $(e_1 + e_2 \ldots + e_N)^{-1} f_{12}\ (34 \ldots N) = (34 \ldots N)(e_1 + e_2)^{-1} f_{12}$ followed from the theory of functions of an operator, but the proof was omitted. A compact proof is now given. (P.C.H.)

11132 NUCLEAR MATTER CALCULATIONS USING THE SEPARATION METHOD. Bruce L. Scott (Univ. of Southern California, Los Angeles) and Steven A. Moszkowski. Nuclear Phys., 29: 665-71(Feb. 1962). (In English)

The convergence of the separation method for calculating the two-body reaction matrix is established for central interactions by comparing the separation method results to those obtained by solving the integral equation numerically. A spin-dependent central well which approximately satisfies two-body data as well as giving reasonable nuclear saturation properties is presented. (auth)

11133 REMARKS OF UNITARITY EQUIVALENCE OF LORENTZ INVARIANT FIELDS. H. Reeh and S. Schlieder (Max-Planck-Institut für Physik und Astrophysik, Munich). Nuovo cimento (10), 22: 1051-68(Dec. 1, 1961). (In German)

Field theories characterized by operators defined on spacelike surfaces are considered, and Haag's theorem is discussed. Properties of the field operator algebra are investigated. It follows that the defined algebra $\mathcal{B}$ is already cyclic. Furthermore, the algebra $\mathcal{A}$, essentially derived by adjoining to $\mathcal{B}$ the projection operator of the vacuum state, is irreducible. (auth)

11134 USE OF NORMAL COORDINATES IN NUCLEAR PHYSICS. F. J. Smith and J. G. Brennan (Catholic Univ. of America, Washington, D. C.). Phys. Rev., 125: 971-2 (Feb. 1, 1962).

It is shown that normal coordinates are not difficult to use in nuclear theory if it is assumed that the masses of the nucleons are equal. In the shell model with harmonic oscillator functions they have the advantage that they exclude the spurious states due to the motion of the center of mass. (auth)

11135 NON-ABELIAN GAUGE FIELDS. COMMUTATION RELATIONS. Julian Schwinger (Harvard Univ., Cambridge, Mass. and Stanford Univ., Calif.). Phys. Rev., 125: 1043-8(Feb. 1, 1962).

The question is raised for non-Abelian vector gauge fields whether gauge invariance necessarily implies a massless physical particle. The action principle is used to discover the independent dynamical variables of such gauge fields and to construct their commutation relations. (auth)

11136 RELATIVISTIC LEE MODEL. Marian Guenther (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 125: 1061-6(Feb. 1, 1962).

A relativistic version of the exactly soluble Lee model of quantum field theory is constructed, which—unlike the original nonrelativistic Lee model—fulfills also the condition of microcausality (field operators commuting or anticommuting for space-like distances). Microcausality is, however, found compatible with solubility only if an indefinite metric is introduced on a much larger scale than was necessary in the nonrelativistic case. Notwithstanding the fact that a formalism of this type would seem to bear still less resemblance to physical reality than does the original Lee model, a theory almost identical with the usual version of relativistic charged scalar (or pseudoscalar) meson field theory is formulated. From a certain point of view these two formalisms can even be considered identical. The difference between the realistic theory and the Lee model hinges on whether, for the representation of the Dirac standard ket $|0\rangle$ a physical vacuum or a suitably defined "completely empty space" is used. The form of the presentation follows closely that of the Pauli-Källén description of the nonrelativistic Lee model, up to the point where it is shown that some of the main results can also be obtained with help of a corresponding Chew-Low equation. (auth)

11137 ON THE UNIQUENESS OF FOCK'S HARMONIC COORDINATE SYSTEMS IN THE PRESENCE OF STATIC, SPHERICALLY SYMMETRIC SOURCES. F. J. Belinfante and J. C. Garrison (Purdue Univ., Lafayette, Ind.). Phys. Rev., 125: 1124-30(Feb. 1, 1962).

Fock's (V. Fock, The Theory of Space Time and Gravitation (Pergamon Press, New York), 342(1959)) "harmonic" coordinate systems in curved space flattening out toward spatial infinity are uniquely determined but for

an arbitrary inhomogeneous Lorentz transformation. Introduction of Fock's harmonic coordinate conditions would provide a natural way of introducing a Lorentz subgroup of the general coordinate transformation group of Einstein's gravitational theory, and of defining a Minkowski metric besides the curved-space metric. This would open the way to close relations between Einstein's gravitational theory on the one hand, and Lorentz-covariant quantum field theory on the other hand. A general proof of the correctness of Fock's claim, for universes satisfying his boundary conditions, was never given rigorously. An earlier proof of this uniqueness for the Schwarzschild field around a single gravitational singularity, is extended to the case of the static and spherically symmetric field generated in some coordinate system by an extended static and spherical distribution of energy and of stresses. The uniqueness (but for the zero point of time and for a spatial rotation) of the harmonic coordinate system, in which this field is spherical and at rest around the spatial origin, is guaranteed by the condition that there must be a one-to-one correspondence between the points x, y, z, t of the harmonic coordinate system and the points in physical space. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

11138 (AROD-2319.3) STUDIES OF OPTIMIZED REACTORS. Final Report. J. R. Lamarsh (Cornell Univ., Ithaca, N. Y.). Sept. 30, 1961. Contract [DA30-069-ORD-2529]. 11p.

The results of theoretical studies of optimized reactor systems carried out at Cornell University are presented. Results of studies on various reactor systems are discussed. (auth)

11139 (CEND-141) THE DEVELOPMENT AND TESTING OF THE UO_2 FUEL ELEMENT SYSTEM. Summary Report. B. E. Murtha and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). June 1961. Contract AT(30-1)-2379. 144p. (NYO-9012)

Progress in the development and testing of UO_2 fuel elements is reported. Vibratory compaction, swaged fuel elements, rock site fuel elements, progressive layer assembly, reduction of cladding thickness, and performance characteristics of UO_2 fuel elements are discussed. (M.C.G.)

11140 (DC-55-6-133) REPORT OF INVENTION ON NUCLEAR FUSES. I. L. Helms, Jr. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 23, 1955. Contract AT(11-1)-171. 15p.

Nuclear fuse designs are described which have operating times of 1 to 2 milliseconds and are temperature-compensated. Diagrams to illustrate design and operation are included. (J.R.D.)

11141 (DC-55-7-96) MEASUREMENT OF FISSION PRODUCT LEAKAGE DURING IRRIDATION TEST OF FUEL ELEMENTS. C. G. Collins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 13, 1955. Contract AT(11-1)-171. 34p.

Progress is described in the development of two procedures for detecting fission product leakage during radiation tests of fuel elements. Use of these procedures will permit the measurement of leakage rates in tests of fuel elements containing deliberately introduced flaws and aid in establishing inspection specifications for production fuel elements. One procedure evaluated consists of collection of the fission products in activated charcoal and subsequent analysis for individual isotopes by gamma spectrometry. It yields results which appear accurate within a factor of two and it is sufficiently sensitive to detect a leakage rate of I^{131} about one-tenth of that permissible for fuel elements tested in the LITR. A second procedure studied consists of gross activity measurements in a fraction of the total air flow of the testing facility using a charged wire collector and scintillation counter. This procedure yields quantitative results when the fission fragments escape immediately after formation and it is useful as a continuous monitor of fission fragment leakage. Both procedures appear applicable to MTR and HTRE conditions. (auth)

11142 (DC-56-5-157) PROGRESS REPORT ON EVALUATION OF CLAD HYDRIDED ZIRCONIUM AS SOLID MODERATOR. V. L. Gelezunas (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 22, 1956. Contract AT(11-1)-171. 21p.

Permeation loss rates of H from hydrided Zr and Mo-clad Zr are reported as a function of temperature. A schematic of the apparatus for obtaining these data is included. A study was initiated to determine the effects of thermal cycling on clad hydrided Zr. The samples were clad with Mo or Nb with an outer coating of stainless steel and were cycled from 700 to 1700°F with no serious deleterious effects. Various phenomena associated with these results are discussed. Radiation effects testing of hydrided Zr in a LITR beam hole was conducted at 1450°F. After this sample cools it will be sectioned and examined. Tests primarily designed to determine the effects of temperature gradients on re-distribution of H in hydrided Zr are partially complete. Data and discussion concerning these tests are included. Methods for establishing H loss from moderators were established, however the primary cause of moderator swelling was not found. No marked diffusional movement of H in clad Zr was found and radiation appears to have no effect on H diffusion in moderator or cladding. (J.R.D.)

11143 (DC 57-1-18) 704 COMPUTER EVALUATION OF ANNULAR REACTOR ANALYTIC, TWO-ENERGY-GROUP ANALYSIS. A. J. Ness (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 15, 1956. Contract AT(11-1)-171. 15p.

Program 0 computes fast and slow flux and fission source distribution at lattice points between two given radii in a bare annular reactor having a central control rod. The problem is computed on the IBM 704 using GEPRO loading and output routines. Machine operation time is approximately thirty seconds per case. (auth)

11144 (DC-57-10-39) FLOW DISTRIBUTION STUDIES USING LEAD ACETATE AND HYDROGEN SULPHIDE GAS. J. Holowach and Fred J. Frank (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 26, 1957. Contract AT(11-1)-171. 19p.

A flow visualization technique was developed, using a hydrogen sulfide-lead acetate reaction, to determine the flow distribution in an A-2 fuel cartridge. Results show that the coolant flow is essentially straight with little interstage mixing. Mixing is confined radially to adjacent annuli and circumferentially at the most, to one quadrant or 90 degrees. In order to mitigate the power scalloping problem, found in most reactor designs, it was proposed to swirl the air 360° while passing through an 18-stage cartridge. The hydrogen sulfide gas-lead acetate reaction technique was used to determine the flow pattern in three XR-27 fuel elements with all ribs turned 20° to the element axis. This design produced approximately a 12° turn of the air. Further tests on pressure loss and structural qualities are planned for the angled rib design. The flow visualization technique of using a hydrogen sulfide-lead acetate reaction produced excellent qualitative flow patterns and has possibilities, with further refinement, of obtaining quantitative results. (auth)

11145 (DC-57-11-65) STRUCTURAL EVALUATION OF A CORRUGATED FUEL ELEMENT. R. A. Stanley and J. Holowach (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 4, 1957. Contract AT(11-1)-171. 16p.

A series of burner rig tests was completed on a corrugated type fuel element which shows the high mechanical strength of a corrugated type construction. An AR-7 type fuel element was successfully tested for 100 hours at a gas temperature of 1850°F and a dynamic head of about 9 psi. (auth)

11146 (DC-60-2-295) AN ALTERNATE METHOD OF COMPUTING RESONANCE ABSORPTION AND RESONANCE ESCAPE PROBABILITY IN INTERMEDIATE REACTORS. P. G. Fischer (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 25, 1960. Contract AT(11-1)-171. 12p.

An approximate method for treating the energy self-shielding, and consequent reduction in resonance absorption, which occurs in strong isolated resonances is outlined, which enables a reasonably gross energy lattice to be retained for multigroup reactor analysis calculations. The procedure makes use of an approximate expression for the neutron flux within a resonance based on the Wigner (Coveyou-Macauley) slowing down model to obtain the resonance absorption integral directly. Since a multigroup calculation must preserve only such integrals, the precomputed resonance absorption may be used directly in the calculation. The proposed procedure is a straightforward adaptation of a procedure used in the MUFT codes. Although less accurate than a detailed slowing-down calculation in which the resonance cross-section structure is preserved, it provides an alternate and presumably satisfactory representation since the predominate physical effect in neutron slowing-down, neutron flux depression in the resonances, is included. One limitation on the method is the necessity for representing each resonance in terms of single-level Breit-Wigner parameters. Extension of the resonance integral calculation to automatically include Doppler broadening is discussed. (auth)

11147 (HW-69594) DISSOLUTION OF URANIUM OXIDES FORMED DURING A FUEL ELEMENT FAILURE. G. E. Neibaur and N. D. Stice (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 15, 1961. Contract AT(45-1)-1350. 17p.

Laboratory and pilot plant work directed toward development of decontamination methods for high-temperature pressurized water systems are described. It is noted that failure and corrosion of metallic U fuel elements in such systems produces uranium oxides with a large percentage of fission products remaining associated with the oxide particles. Decontamination requires dissolution and/or flushing of these oxides from the system. A summary of specific tests involving promising solutions is presented. (J.R.D.)

11148 (IDO-16743) SPERT III PRESSURIZER VESSEL FAILURE. R. E. Heffner, T. R. Wilson, D. P. Halls, W. W. Hickman, and K. R. Hoopingarner (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 29, 1962. Contract AT(10-1)-205. 183p.

On October 26, 1961, at approximately 8:00 P.M. a failure occurred in the Spert III pressurizer vessel, an integral component of the primary coolant system of the Spert III reactor facility. At the time of failure, the reactor contained a subcritical array of fuel, and non-nuclear tests were being conducted to evaluate experimental procedures and the performance of plant equipment in preparation for a series of cold water accident studies scheduled to follow. Subsequent investigations have led to the conclusion that because of error in the indication of the existing level-control instrumentation on the vessel, it was possible for one or more of the electric heaters to operate above the steam-water interface thus causing superheating of the steam and producing overtemperature in the upper half of the vessel. The failure mechanism was third-stage creep at elevated temperatures. Included are the results of the study of the cause of failure. Supporting evidence is presented to enable the reader to make an independent analysis of this and other possible causes of the failure. (auth)

11149 (LA-2654) THE PERIOD EQUILIBRIUM EFFECT IN REACTOR DYNAMICS. Sidney Singer (Los Alamos Scientific Lab., N. Mex.). Jan. 1962. Contract W-7405-Eng-36. 104p.

Nuclear reactors have two "equilibrium" modes: one where the reactor power is constant (zero excess reactivity), and the other where the reactor period is a constant (constant, nonzero excess reactivity). The small-signal transfer functions for these equilibrium modes are appreciably different; and reactor control systems that are designed to have an adequate stability margin when a reactor power equilibrium transfer function is used may not be stable when reactor periods of a few seconds are maintained. The derivation of the small-signal period equilibrium transfer function is presented, and IBM 7090 tabulations and graphs are given that define this transfer function for a range of neutron mean lifetimes and asymptotic periods of 10^{-3} to 10^{-6} sec and 1×10^{8} to 1×10^{-2} sec, respectively. (auth)

11150 (NMI-7210) EVALUATION OF THE DEMONSTRATION SET OF ZIRCALOY-4-CLAD UNALLOYED URANIUM INNER TUBES NOS. 116-121, EXTRUSION NOS. 30795 TO 30800. W. L. Larson (Nuclear Metals, Inc., Concord, Mass.). Aug. 11, 1961. Contract AT(30-1)-1565. 42p.

Data obtained in the evaluation of Tubes 116 through 121, extrusions No. 30795 through 30800, are presented. These 6 inner tubes with unalloyed uranium cores and of identical design were made to demonstrate the reproducibility of the fabrication process. One of the tubes was processed as a flow test tube and was not heat treated. The remaining 5 tubes were beta treated. The tubes No. 116, 117, 118, 119, and 121 met all specifications. Tube No. 120 met all specifications except that notch-fracture tests of end seal samples indicated inferior bonding between zirconium and Zircaloy on the outer cladding. (M.C.G.)

11151 (NUMEC-P-36) DEVELOPMENT OF PLUTONIUM BEARING FUEL MATERIALS. Monthly Progress Letter for November 1961. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). Dec. 5, 1961. Contract AT(30-1)-2389. 9p.

Major effort is reported on chemical processing and product characterization. Material recycle problems were investigated by conducting oxalate precipitations from dilute plutonium nitrate solutions. PuO_2 was also prepared via the plutonium peroxide route. Continued studies are also reported on UO_2-PuO_2 coprecipitation, powder characterization, and coating techniques for deposition of Ni and Cu on PuO_2. Plasma-torch-produced PuO_2 spheroids were of good quality but much smaller than the feed material. Initial fabrication of UO_2-PuO_2 is reported and investigation of Pu_2O_3 formation during sintering was continued. Research on a near-thermal reactor system was also continued. (J.R.D.)

11152 (NYO-9587) APPLICATIONS OF ULTRASONIC ENERGY. ULTRASONIC FILLING OF TUBULAR CLADDING WITH CERAMIC FUEL POWDERS. William B. Tarpley and Richard Pheasant (Aeroprojects, Inc., West Chester, Penna.). Nov. 1961. Contract AT(30-1)-1836. 40p.

Direct cold compaction of powdered fuels within cladding materials offers many economies in fuel element fabrication, particularly with reprocessed and enriched fuels. Ultrasonic vibratory filling of cladding tubes under low restraining pressures (well below one ton per square inch) was explored and found to be superior to both low frequency vibratory compaction and cold pressing, as well as to have

certain advantages over the sintered pellet process. Three points of ultrasonic application were studied: axial coupling to bottom of fuel tube, flexural coupling to side of tube, and axial activation of restraining load. Using combinations of these, the following materials were compacted to the indicated percentages of theoretical density: urania (fused, ground, sized) 92%; urania (ceramic grade) 67%; thoria (ORNL process, sized, blended) 92%; and alumina (ceramic grade) 63%. Still higher densities appeared possible with ceramic grades, through investigation to optimize interaction between material properties and points of ultrasonic application. The ultrasonic technique, which permits easy isolation of the activated tubes, is particularly adaptable to reprocessed and enriched fuel powders which may require use of glove boxes or shielding. Powders of widely different density remain essentially homogeneous. No deformation of cladding was observed. (auth)

11153 (ORO-501) COLUMBIUM ALLOY CLAD URANIUM CARBIDE FUEL ELEMENT. Technical Report No. 61-33. M. Korchynsky, J. J. Finley, J. L. Wilson, S. S. Sarian, and H. J. Brown (Union Carbide Metals Co. Metals Research Labs., Niagara Falls, N. Y.). Sept. 15, 1961. Contract AT-(40-1)-2559. 84p.

Methods of fabricating uranium monocarbide by powder metallurgical techniques are described. Experimental work includes cold-pressing and sintering, vacuum hot-pressing, liquid-phase sintering, and slip-casting. Uranium monocarbide powder for these experiments was produced by the methane-uranium metal reaction. The effect of the various process variables on the powder characteristics is discussed. Compatibility of sintered uranium carbide with selected niobium-base alloys was explored in the range of temperatures from 1000 to 1600°C. In the absence of oxygen contamination of the environment these materials are compatible to at least 1000°C. In determining the microhardness of uranium monocarbide and UC_2, the microhardness of UC_2 was found to be strongly orientation dependent. (auth)

11154 (SL-1857-7) REACTOR CONTAINMENT DESIGN STUDY. Bimonthly Progress Report [for period] October 15, 1961 to December 15, 1961. R. A. Johnson (Sargent and Lundy, Chicago). Dec. 26, 1961. For Illinois Inst. of Tech. Armour Research Foundation, Chicago. Contract AT(11-1)-938. 33p.

Preparation of general arrangement drawings is reported for the 300-Mwe reactor direct-cycle pressure relief concept for containers along with the pressure suppression, low pressure, and total containment concepts. Calculations for the containment design pressure as well as calculations of radiation levels at the exclusion area boundaries were also completed for these concepts. A preliminary draft of the supplementary study of reactor containment design was initiated. (J.R.D.)

11155 (TID-14964) STUDIES OF REACTOR CONTAINMENT. Monthly Technical Progress Report No. 56 [for] period December 1, 1961 through December 31, 1961. T. A. Zaker (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 22, 1962. Contract AT(11-1)-528. 5p.

Major effort during the period was devoted to the development of a chapter outline for use in organizing problem areas. Activities concerning development of design procedures for blast shields, and design criteria for external containment structures are also reported. (J.R.D.)

11156 (VDIT-49) THE DESIGN OF CONTROL RODS FOR NUCLEAR REACTORS. A Literature Survey. E. Bock (Aktiebolaget Atomenergi, Stockholm). Dec. 1961. 31p.

A bibliography of 79 references with appended abstracts is presented which covers the period 1958 to 1961. An author index is included. (D.L.C.)

11157 (WAPD-243) SALT BATH HEAT TREATMENT OF PWR CORE 2 FUEL ELEMENTS. D. Jaffe and E. F. Losco (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1962. Contract AT-11-1-GEN-14. 44p.

Previous investigations established that the Zircaloy cladding of PWR Core 2 seed and blanket fuel elements pressure-bonded in the alpha-plus-beta field possessed inadequate corrosion resistance and that high corrosion resistance could be restored to Zircaloy in this two-phase condition by an additional heat treatment in the all-beta field followed by rapid cooling. Work was undertaken to determine the feasibility of performing this beta treatment on PWR Core 2 fuel elements in a molten salt bath on a production basis and, if feasible, to determine the metallurgical parameters for the process. To this end a vertical salt bath capable of beta-treating production-sized (55 × 4-inches) fuel elements was improvised using available components, and experiments were performed using both solid Zircaloy plates and pressure-bonded PWR Core 2 seed and blanket fuel elements. It was found that salt bath beta treatment was a feasible production process, and the process parameters were established. (auth)

11158 (WAPD-T-1235) A NYQUIST CRITERION FOR SPATIAL XENON STABILITY. S. G. Margolis (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1960. Contract AT(11-1)-gen-14. 15p.

Presented at American Nuclear Society Winter Meeting, December 1960, San Francisco.

A method of predicting reactor stability against Xe oscillations is described in which the coolant density feedback and pointwise variation of Xe dynamics are taken into account. The method was found to be computationally feasible, and the results are presented in a form usable as a designing tool for stability. (J.R.D.)

11159 (WAPD-T-1236) A SIMPLE APPROXIMATE TEST FOR SPATIAL XENON STABILITY. D. R. Harris and P. S. Lacy (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1960. Contract AT-11-1-GEN-14. 7p.

Presented at American Nuclear Society Winter Meeting, Dec. 1960, San Francisco.

An approximate test for spatial xenon stability which employs existing group-diffusion codes is described and compared with oscillations simulated by the CANDLE code. A two-energy-group model was employed. (M.C.G.)

11160 (WAPD-T-1241) MULE—A CODE FOR THE CALCULATION OF THREE TYPES OF OVERTONE MODES. R. L. Ewen (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1960. Contract AT(11-1)-Gen-14. 25p.

[Presented at] American Nuclear Society Winter Meeting, December 1960, San Francisco, California.

The Wielandt method for the calculation of the roots in the matrix of the eigenvalue problem in reactor design is reviewed in contrast to that of the basic power method. An application is made of the Wielandt method to three types of modes of interest in reactor kinetics. A description is given of the MULE code for the calculation of these modes in slab geometry. (B.O.G.)

11161 (JPRS-12161) NUCLEAR REACTOR START UP SIMULATOR. Wieslaw (Veslav) Filipczak. Translated from Nukleonika, 6: 387-98(1961). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract No. 3909.

11162 THE CHARACTERISTICS REQUIRED BY A REACTOR FOR ITS AUTOMATION. I. Udrea, L. Măntescu, and C. Haraga (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercĕtari fiz., 12: 595-604(1961). (In Rumanian)

The characteristics of a reactor soon after its shutdown were studied in order to establish the conditions of its start-up and of the behavior in the automatic start-up. The variation of the reactivity, the neutron source, and the sensitivity of the measurement devices were analyzed. By the use of compensated ionization chambers, the automatic system is not affected by the conditions of a start-up after shut-down. (tr-auth)

11163 BEHAVIOR OF THE WATER IN THE PRIMARY CIRCUIT OF A REACTOR. D. Stoian and I. Gălăteanu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 605-8(1961). (In Rumanian)

The variation of the composition of the fixed residue, as well as the concentration of organic substances and the pH of the distilled water, in the reactor is indicated. A comparison of the behavior of the water before and after the introduction of an ion exchange filter in the circuit is made. (tr-auth)

11164 STUDY OF A URANIUM ROD ASSEMBLY OF THE BR-5 REACTOR. V. I. Galkov, V. I. Ivanov, G. N. Smirenkin, and A. P. Smirnov-Averin. Atomnaya Energ., 12: 56-7(Jan. 1962). (In Russian)

In order to obtain information on the isotopic composition of irradiated fuel elements and on certain other characteristics of the Pu oxide-fueled BR-5 fast reactor, a portion of the U reflector was investigated after a 100-day long exposure to an integrated flux of about $5 \cdot 10^{21}$ n/cm^2. The center of the material examined was located 12.6 cm from the center of the reactor. The number of fission was calculated from the absolute Cs^{137} activity while the number of captures in U^{238} was derived from the specific α activity of samples taken from various locations. The neutron leakage in the reactor was high as a result of the many Na-filled channels. The concentration of Pu^{240} which was found to be about 0.1% was determined by comparing the number of spontaneous fissions in test samples and in reference samples using an ionization chamber. The experimentally obtained ratio of the average capture and fission and capture cross sections agrees well with the value of 1.93 calculated from 18 neutron spectrum group constants and with data obtained with natural U. The average capture cross section of Pu^{239} was found to be equal to 0.415 ± 0.035 barn while the capture and fission cross section ratio was 0.19 ± 0.02. The value of this ratio decreased rapidly from the center of the core toward the periphery of the core because of the influx of neutrons into the core which were slowed down by elastic and inelastic collisions in the Ni screen. (TTT)

11165 THE CONTROL OF NATURAL URANIUM PRESSURIZED WATER REACTORS. D. von Haebler (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Atomwirtschaft, 6: 593-7(Dec. 1961). (In German)

The control of natural uranium, pressurized water reactors is discussed, using the Siemens multipurpose research reactor (MZFR) as an example. After a technical description of the reactor, its intrinsic behavior, especially in the power sphere, is described. The necessity of using the station for grid power control was fundamental in determining the layout of the power control system. The control of the reactor is dependent on the primary cycle temperature. (auth)

11166 NUCLEAR TECHNICAL ACCESSORIES. G.-W. Detjen (Leybold-Hochvakuum-Anlagen GmbH, Cologne). Atomwirtschaft, 6: 598-600(Dec. 1961). (In German)

Nuclear technical accessories which completely fulfill operational requirements are a primary requisite for dealing with radioactive substances and for the operation of nuclear technical installations. The correct arrangement of such equipment determines the operating time and utilization of these installations. A few problems concerning the manufacture of such accesories for loading and unloading a reactor are discussed. (auth)

11167 AN ORGANIC MODERATED REACTOR FOR PROCESS HEAT. B. D. Baines and J. M. Conway-Jones. Brit. Chem. Eng., 7: 112-16(Feb. 1962).

A review is given of the potentialities of an organic moderated reactor for the supply of heat to factories having a large demand for low-pressure steam, together with a requirement for power produced by back-pressure turbine generation. By choosing a suitable steam cycle it is possible to cover the range of typical power demand/head load ratios found in the chemical industry. The economic developments of a reactor installed for such a duty are briefly considered to show the reductions in operating cost that might be brought about during the operating lifetime of the reactor and its associated plant. (auth)

11168 THE DEVELOPMENT OF FLUID FUEL REACTORS. Alvin M. Weinberg (Oak Ridge National Lab., Tenn.). J. Brit. Nuclear Energy Soc., 1: 30-48(Jan. 1962).

There are two incentives for pursuing the development of fluid fuel reactors; one short-term, the other long-term. The short-term incentive is that successful fluid fuel reactors should have lower fuel-cycle costs than any other reactor type; hence, to their proponents they look like one of the very few reactors which can possibly be economically competitive in an era of abundant coal. The long-term incentive is that fluid fuel reactors seem to be almost the only systems which can lead to economical breeders, and which can therefore serve mankind forever as a practical means of "burning the rocks" — that is, utilizing the unlimited resources of thorium in the earth's granitic rocks. The feasibility of the fluid fuel reactors is illustrated by the design, operation, and performance of the HRE-1, HRE-2, Aircraft Reactor Experiment, and Molten Salt Reactor Experiment. (N.W.R.)

11169 CLEANLINESS CONTROL AND THE CLEANING OF RESEARCH REACTORS. S. Ōnishi. Mitsubishi Nippon Jukogyo Giho, 2: 39-48(1961). (In Japanese)

The successful and safe operation of a reactor depends on the cleanliness of the components during fabrication and construction. Cleanliness control must be strictly carried out according to the specified cleaning procedures to prevent contamination. Information is given on the mechanisms and specifications for cleaning, based on experience gained in the construction of the JRR-2 and JRR-3 of JAERI at Tokai-village, Ibaragi prefecture, Japan. (auth)

11170 MEASUREMENTS ON SUBCRITICAL D_2O MODERATED REACTOR ASSEMBLIES. H. Meister (Institut für Neutronenphysik und Reaktortechnik, Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 3: 236-46(Nov. 1961). (In German)

In an exponential experiment the multiplication characteristic magnitudes of various heavy water moderated reactor assemblies were measured. The lattice studied consisted of a quadratic arrangement of cylindrical natural uranium rods (32 mm diameter) with 1 mm thick aluminum can (fuel rods of the FR-2 Research Reactor); the lattice distances d were varied in the range from 10.8 to

24.0 cm. By measurement of the macroscopic flux distribution within a tank of 136-cm diameter, the material formfactor ("material buckling") B_m^2 was determined with the help of a BF_3 counter. These measurement values were in good agreement with those obtained by Cohen on similar assemblies. By measurement of the microdistribution of the thermal flux within a lattice cell with small Mn probes, the ratio of the mean flux value in the moderator and fuel element and therefore the thermal utilization $\underline{f}$ and the effective diffusion length $\underline{L}$ were determined. The ratio found is about 2 to 3% higher than the corresponding value found by Cohen. From the magnitudes B_m^2, L^2, and the Fermi age, the multiplication factor k_∞ was calculated, and the value $\eta = 1.307 \pm 0.015$ was found by an extrapolation method given by Mummery. (tr-auth)

11171 AUTORADIOGRAPHIC POWER DISTRIBUTION MEASUREMENTS IN NUCLEAR REACTORS AND ANALYSIS BY DIGITAL COMPUTER METHODS. C. G. Chezem and R. H. Moore (Los Alamos Scientific Lab., N. Mex.). Phot. Sci. Eng., 5: 343-8(Nov.-Dec. 1961).

Measurement of the fine structure of the power distribution in a reactor or critical assembly can be accomplished by irradiating sandwiches of both fissionable foils and inert foils in the system. Such thin foils are adaptable to nearly any geometry of the machine; perturb the system in a minimum; and, when removed and placed in contact with a photographic emulsion, leave a permanent record of the power distribution in the photographic image. Resolutions to about 1 mm can be obtained with relative ease and little expense. Each film can be calibrated individually to minimize the effect of processing irregularities. An iterative method of fitting mathematical functions to the calibration-densitometric data in which the parameters appear nonlinearly is discussed in language compatible with any high-speed digital computer. Suggestions are offered to photographic scientists and computer programmers based on extensive Los Alamos experience concerning the formulation and operation of such iterative routines, interpretation of the precision indicators of the parameters, convergence criteria, and the prevention of nonconvergent oscillations. (auth)

11172 OPTIMIZATION OF SPACING OF NATURAL URANIUM FOR VARIOUS MODERATORS. [PART] I. A. Morales y Amado and A. Serment C. (Universidad Nacional de Mexico, Mexico City). Rev. mex. fis., 10: 309-37(1961). (In Spanish)

For a cylindrical natural uranium and light water subcritical system, an optimum cell and uranium rod radius was found among all the cells and rod radii studied: $k_\infty = 0.97$, $r_0 = 1$ cm, $r_1 = 1.8$ cm. The feasibility of interchanging natural uranium rods from the $U-H_2O$ subcritical system to a $U-D_2O$ critical zero power system was shown possible utilizing only optimum diameter rods. The effect of an air gap around the uranium rod, for the light water system, was studied and it was shown that for a given cell and rod radius, there was an air gap thickness that optimized the infinite multiplication factor. Some estimates on the masses of both the subcritical natural $U-H_2O$ and the critical $U-D_2O$ systems are given. Monoenergetic diffusion theory was used and all computations were done on the IBM-650 computer of the University of Mexico. (auth)

11173 IMPROVEMENTS IN ASSEMBLIES INCLUDING ELEMENTS HAVING ANISOTROPIC EXPANSIONS. Roland Roche (to Commissariat à l'Énergie Atomique). British Patent 889,388. Feb. 14, 1962.

A method is given for assemblying two elements of anisotropic expansion properties in such a way that the initial play is maintained without any substantial variation. The method is particularly useful in assembling graphite bars to form reactor moderator structures which must withstand Wigner growth. (D.L.C.)

11174 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Ivor Kent, Gordon Packman, and Peter Waine (to United Kingdom Atomic Energy Authority). British Patent 889,536. Feb. 14, 1962.

A fuel element design for operation in gas-cooled reactors at 500 to 600°C is presented. It comprises end-stacked clusters of sheathed fuel members located at their ends in support structures, their other ends being free to expand longitudinally; a graphite sleeve encloses and supports the fuel cluster assembly. Provision is made for lifting and lowering the fuel element into the reactor. (D.L.C.)

11175 IMPROVEMENTS IN NUCLEAR REACTORS. Ronald James Hawkins (to Babcock & Wilcox Ltd.). British Patent 889,636. Feb. 21, 1962.

A relatively simple and inexpensive restraining means is designed to hold a gas-cooled graphite core together. The restraining means comprises loaded toggle joints distributed around the core and adapted to exert thrusts between rigid abutment means and the core. (D.L.C.)

11176 A CONTROL AND SHUT-DOWN DEVICE FOR A NUCLEAR REACTOR. (to Siemens-Schuckertwerke A. G.). British Patent 889,702. Feb. 21, 1962.

A control and shut-down device is designed which enables its neutron absorption to be made zero without removal of the absorber member from the core. The device comprises a neutron-absorbing member, a second member covering the first member, and means for effecting relative movement between the two members. The absorber member has zones of absorber material alternating with non-absorbing zones, and the second member has zones of fissionable or reflector material alternating in a similar way with zones free from such material. The pitches of the alternations on both members are equal, and the absorber member can be moved a short distance from an inactive position (absorber zones fully covered) to an active positon (absorber zones bare). (D.L.C.)

11177 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Alan James Williams and John Davidson McKean (to English Electric Co., Ltd.). British Patent 889,758. Feb. 21, 1962.

A device is designed for transmitting lateral shock loads from the biological shield to the core support grid and for permitting relative radial movement between the pressure vessel and both the support grid and the biological shield. The device comprises a plurality of radial sliding key and keyway means spaced around the pressure vessel and arranged to interconnect the pressure vessel both with the biological shield and with the support grid. The device is useful for gas-cooled, graphite-moderated reactors subjected to earthquake conditions. (D.L.C.)

11178 IMPROVEMENTS IN OR RELATING HEAT EXCHANGE ARRANGEMENTS AND MORE PARTICULARLY TO FUEL DEVICES FOR NUCLEAR REACTORS. Arthur Lymer (to Simon-Carves Ltd. and General Electric Co., Ltd.). British Patent 889,902. Feb. 21, 1962.

Fuel elements may be designed with baffles to prevent vibrations due to interactions of oscillatory vortices in the coolant flow. The baffles may be planar or wedge-shaped and are attached to the fuel elements or fins thereof, preferably in a direction parallel to the fuel element axis and to the direction of coolant flow. (D.L.C.)

11179 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Andre Huet. British Patent 890,330. Feb. 28, 1962.

A modification of the reactor described in British Patent 857,675, in which control is effected by moving the fuel rods together or away from each other by means of articulated quadrilaterals, is described. A fixed point is provided for each control so that the movement of the fuel rods is effected about this fixed point, and the modification consists of a device for shifting the fixed point in case some of the fuel rod rows are removed from the reactor. (D.L.C.)

11180 IMPROVEMENTS IN NUCLEAR REACTORS AND IN RESTRAINT GARTERS THEREFOR. John David Dell (to Babcock & Wilcox Ltd.). British Patent 890,520. Feb. 28, 1962.

A temperature-compensated restraint garter for holding a reactor core together is designed which has an effective coefficient of thermal expansion equal to that of the material of the stack which it surrounds. The garter comprises a continuous series of stays and tie rods and includes a series of levers adapted to rock from thermal expansion and dimensioned to give a circumferential expansion equal to the thermal expansion of the adjacent part of the stack. (D.L.C.)

11181 FUEL ELEMENT. Robert C. Howard and Jack C. Bokros (to U. S. Atomic Energy Commission). U. S. Patent 3,024,181. Mar. 6. 1962.

A fueled matrix containing uncombined carbon is designed for use in graphite-moderated gas-cooled reactors designed for operation at temperatures (about 1500°F) at which conventional metallic cladding would ordinarily undergo undesired carburization or physical degeneration. The invention comprises, broadly a fuel body containing uncombined carbon, clad with a nickel alloy containing over about 28 percent by weight copper in the preferred embodiment. This element is supported in the passageways in close tolerance with the walls of unclad graphite moderator material. (AEC)

Power Reactors

11182 (ACNP-6107) PATHFINDER ATOMIC POWER PLANT NOZZLE GALLING TEST, FINAL REPORT. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Dec. 29, 1961. For Northern States Power Co. Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 26p.

Galling tests of 304, 17-4PH, and chrome-plated 304 stainless-steel nozzles with 304 stainless-steel sleeves were conducted at Pathfinder reactor conditions of 489°F, 600 psig. A horizontal force was imposed on the sleeve with the nozzle inserted; and the nozzle was moved axially to determine galling tendencies. Galling was produced on both the 304 and 17-4PH stainless-steel nozzles. The chrome-plated 304-stainless-steel nozzles were cycled numerous times without galling. On the basis of these tests, chrome-plated 304L-stainless-steel is the material selected for the Pathfinder boiler fuel-element nozzle. (auth)

11183 (ACNP-62001) PATHFINDER ATOMIC POWER PLANT ANALOG SIMULATOR. D. H. Crimmins, D. Mohr, and J. T. Stone (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Jan. 31, 1962. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 96p.

The steady-state and dynamic characteristics of the Pathfinder systems were simulated on a dual-console Pace Analog Computer. The derivation of the system equations, the assumptions involved, their numerical evaluation, and their conversion to analog circuitry are described. The Pathfinder system is unique because of the internal nuclear superheater, and controlled, forced recirculation. In simulating this system the following major assumptions were made: the reactor is a boiling-water type; moderated and cooled with saturated, light water; pressurized between 400 and 800 psia; and has a neutron flux distribution that is spatially invariant. All the important non-linearities are retained, thus permitting accurate solutions of large system disturbances. The neutron kinetics equations, with their six groups of delayed neutrons, are simulated with power feedbacks through reactor pressure, steam flow, core inlet subcooling, and fuel-element temperature. Particular attention is devoted to the accurate simulation of fuel-element heat transfer; the reactor pressure-control system, which operates the turbine inlet valves; and the effect of core inlet subcooling, since these were found to have pronounced effects on reactor performance. The transient temperatures at the superheater hot spot and exit are generated. Enough flexibility is included, so that all important disturbances possible in the actual plant can be run on the simulator. Changes in system parameters are easily accomplished by merely changing potentiometer settings. The prime objectives of the reactor simulator are to establish a control system for Pathfinder and optimize its settings, to investigate system stability under all conditions, to compute results of postulated system disturbances and accidents, and to help obtain system characteristics useful in formulating plant operating procedures. (auth)

11184 (AI-5272) 75,000 KILOWATTS OF ELECTRICITY BY NUCLEAR FISSION AT THE HALLAM NUCLEAR POWER FACILITY. F. C. Gronemeyer (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.) and J. W. Merryman (Bechtel Corp., San Francisco). 1960. 69p. Contract [AT-11-1-GEN-8].

For presentation at ASCE Convention in Reno, Nevada on Thursday, June 23, 1960.

A description of the Hallam Nuclear Power Facility is presented. The history of the project, program participants, site description, component development program, reactor building, reactor structure, reactor core, sodium systems, instrumentation and control, fuel and component handling, auxiliary sustems, special design features, and advantages of sodium graphite reactor systems are discussed. (M.C.G.)

11185 (ANL-6484) STABILITY ANALYSIS OF EBR-II. H. H. Hummell and L. T. Bryant (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-eng-38. 18p.

Calculations were made for predicting the resonance of EBR-II to oscillator measurements to be made during startup of the reactor. Because of assumptions made in the calculations, which are believed to be justified by the design of the reactor, the only feedbacks are prompt negative ones. No instability in the calculated behavior is therefore possible. The radially lumped pin model gives good results for EBR-II pins for frequencies up to 2 to 3 radians per second because of the short pin time constant, of the order of 0.1 sec. (auth)

11186 (ANL-6494) CRITICAL STUDIES OF A FAST REACTOR CORE CONTAINING DEPLETED URANIUM AND SODIUM AS DILUENTS. (APR-III Assembly 36). J. M. Gasidlo, J. K. Long, and R. L. McVean (Argonne National Lab., Idaho Falls, Idaho). Jan. 1962. Contract W-31-109-eng-38. 23p.

Critical studies were performed with a metallic, fast reactor core designed to investigate the effects of replacing highly absorbing U^{238} diluent with high-scattering, low-absorbing sodium diluent. The fuel was 15.7 wt % enriched U^{235} and the core contained 18.2 vol % sodium and 12.68 vol % stainless steel. The experimental program was designed to measure the effect of the material replacement on spectral indices, which consisted of the standard fission ratios, foil irradiations, and a large number of central reactivity coefficients. Other measurements included the Rossi-α, radial fission traverses, and edge reactivity worths of a few samples. (auth)

11187 (ANL-6509) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JANUARY 1962. (Argonne National Lab., Ill.). Feb. 15, 1962. Contract W-31-109-Eng-38. 52p.

Items of significant technical progress which occurred in specific reactor projects and in general engineering research and development programs are reported. Specific developments are reported concerning the EBWR, Borax-V, EBR-I and II, and the Fast Reactor Test Facility (FARET). General research and development is reported on evaluation of carbide and oxide fuels, isotopic power sources, metallography of fissium alloys, ZPR III, VI, and IX experiments, and Juggernaut critical experiments. Developments in general reactor technology are reported in the areas of applied reactor physics, fuels, materials, and components development, heat engineering, and separations. Other work is reported on direct conversion devices and in the area of nuclear safety. (J.R.D.)

11188 (APAE-Memo-302) SM-1 REACTOR VESSEL COVER AND FLANGE STRESS ANALYSIS. M. F. Sayre (Alco Products, Inc., Schenectady, N. Y.). Feb. 19, 1962. Contract AT(30-1)-2639. 33p.

The maximum stress calculated for the SM-1 reactor vessel closure studs occurs during operation at full power. This value is 27,180 psi of which 19,800 psi is tension and 7380 psi bending. This stress does not include a stress concentration factor for effect of threads. It was conservatively assumed the studs were initially tightened to a code allowable stress of 20,000 psi as specified in the ASME Code rather than the lesser stress obtained by the normal operating procedure. The maximum calculated stress occurs at the outside surface of the cover where the stress ranges from 318 psi in tension to 99,660 psi in compression. The alternating stress is 50,000 psi. According to the Navy Code for a stress range of 50,000 psi, the cover material can safely undergo a maximum of 1600 cycles. It was estimated that the SM-1 will go through approximately 900 startup and shutdown cycles during a 20-yr life period, so the calculated stress is regarded as safe. For a transient condition of 30°F/hr during heat-up, approximate temperature differences between the inside and outside surfaces of the cover were obtained. Temperature differentials between the inside and outside surfaces of the cover are increased by roughly 10% above the steady state condition. More exact calculations of the transient stresses did not appear necessary since they would be not more than 10% greater than the steady state thermal stress. (auth)

11189 (APEX-666(Pt.1)) FINAL REPORT ON THE DEVELOPMENT PROGRAM OF THE ADVANCED CONTROL COMPONENTS UNIT. N. Haberman, J. F. Hemmenway, J. G. Hiniker, P. J. Horvath, W. C. Kuhlman, A. G. Robison, J. A. Russell, A. L. Spivak, and D. L. West (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 15, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 215p.

Electronic Control Devices. The development of logic circuits using the solid state static switching module is described. A silicon-controlled rectifier amplifier was designed to supply power to a controlled temperature heating element with a pyrometer feedback. The development of a high-performance tunnel diode amplifier for use with fission chamber pulse outputs is described. Control Mechanisms. Work on a reactivity control system in which balls are moved within a tube or other guide is described. A magnetic actuator was developed for moving a series of magnetic drive balls and nonmagnetic poison balls through a continuous tube loop. A test rig was build to demonstrate the concept of reactor control by spring-loaded poison slugs, and the test results are summarized. Instrumentation. Development results are given for thermoelectric and thermionic devices for power and temperature measurement. The possibility of developing a wide-band two-color optical pyrometer is discussed, and studies of existing total-radiation and two-color optical pyrometers were made. Specifications are included for several pieces of pyrometer equipment. The use of corundum and fused silica as light guides in thermal-radiation pyrometry is discussed. Initial development work on a temperature sensor utilizing the change in dielectric constant with temperature is given. Two commercial ten-junction thermopiles were exposed to a gamma field of $\sim 10^6$ r/hr dose rate; no effects were found aside from the small outputs which are ascribed to the parallel resistors. Studies were conducted which indicate the feasibility of using an electrical arc to detect cracks in ceramic components at high temperatures. (D.L.C.)

11190 (BAW-1240) SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM. Quarterly Technical Report No. 5, July–December 1961. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Contract AT(30-1)-2602. 121p.

The work done on the Spectral Shift Control Reactor Basic Physics Program during the fifth contract quarter is summarized. Critical experiments were performed with 4%-enriched UO_2 fuel rods in moderators containing 0 and 50% D_2O, and with 93%-enriched UO_2-ThO_2 fuel rods at 60% D_2O. Measured were critical mass, buckling and reflector savings, thermal disadvantage factor, cadmium ratios of U^{235} and U^{238}, and epithermal neutron spectrum. A radially zone-loaded assembly was studied at a D_2O concentration of 82%. This assembly contained 93%-enriched UO_2-ThO_2 fuel in the inner zone and 4%-enriched UO_2 fuel in the outer zone. Also measured were critical mass, axial buckling, cadmium ratios of U^{235} and Th^{232}, thermal disadvantage factor, thermal flux distribution, and power distribution. Exponential experiments extended the range of measurements to D_2O concentrations above those that could be achieved in the critical experiments. The material buckling and cadmium ratio of U^{235} were measured at room temperature in lattices of 4%-enriched UO_2 fuel at 81 and 89% D_2O. Earlier measurements on 93%-enriched UO_2-ThO_2 lattices were revised. Preparations for an exponential experiment at elevated temperatures (4%-enriched fuel and 81% D_2O) were completed. Reported and discussed are the final results of neutron age measurements in a lattice of ThO_2 rods at D_2O concentrations between 0 and 90%. The final revision of the BPG code and the calculational methods used to analyze the data are reported. Final calculations of criticality, buckling, disadvantage factor, cadmium ratios of U^{235} and U^{238}, spectrum, and neutron age were completed and are compared with experimental data. In most cases agreement

is satisfactory, but the disadvantage factors and the neutron ages still show some disagreement at low D_2O concentrations. Some calculations supporting the design and interpretation of the experiments are reported. (auth)

11191 (CEND-147) THE DEVELOPMENT AND TESTING OF HOMOGENEOUS CERAMIC FUELS. Progress Report for Period June 1 through September 30, 1961. G. Zuromsky and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Oct. 1961. Contract AT(30-1)-2379. 52p. (NYO-2996)

Phase relationship studies on the UO_2-ZrO_2-CaO and UO_2-CeO_2 systems were continued. Results for $CaO-UO_2-ZrO_2$ systems indicated that the composition limits for the single-phase face-centered cubic region are similar for both hydrogen- and argon-sintered specimens after isothermal anneals in argon. Studies of the UO_2-CeO_2 system indicated a single phase face-centered cubic region for air-fired samples containing up to 21 mole % UO_2. Above this UO_2 content, there appeared to be two face-centered cubic phases. The construction of a high-temperature x-ray diffractometer specimen holder was completed. Thermal conductivity measurements on the systems were completed. Forty-two day corrosion tests in 360°C degassed water were also completed. All samples showed a high initial corrosion rate which was greatly reduced as testing time was increased. Thermal performance tests were carried out. (M.C.G.)

11192 (CEND-1009) SL-1 ANNUAL OPERATING REPORT, FEBRUARY 1960–JANUARY 3, 1961. (Combustion Engineering, Inc. Nuclear Div., Idaho Falls, Idaho). June 15, 1961. Contract AT(10-1)-967. 117p. (IDO-19024)

The plant was operated from Feb. 1959 until Jan. 3, 1961 when a nuclear excursion rendered the plant inoperable. A summary of operations is presented for the period Feb. 1960 until the incident. Plant operational time during the period was 78% of that available. Satisfactory operation of conventional plant equipment was observed during 196 startups and scrams. An inspection of fuel assemblies after 700 Mwd showed no damage except to the B–Al strips attached to these assemblies. A greater than predicted gain in core reactivity was attributed to boron loss. Control rod sticking occurred 53 times in 2,730 cases of operation. Test results on a PL-type condenser showed that its performance meets design rating. Steam quality remained greater than 99% for power levels up to 4.7 Mw(t) and radiation in the main steam system continued to be satisfactorily low. Waste handling requirements were increased but posed no problem. (J.R.D.)

11193 (DC-55-8-109) GENERALIZED XENON POISONING CURVES FOR USE IN REACTIVITY CALCULATIONS. Robert M. Cohen and H. R. Dries (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 25, 1955. Contract AT(11-1)-171. 8p.

The ratio of Xe^{135} concentration to that of U^{235} for reactors operating in the thermal flux range of 10^{13} to 10^{15} neutrons/cm^2/sec is presented graphically. Equilibrium Xe calculations were carried out for reactor operating temperatures at 68.8 to 2100°F, while the effect of reactor shutdown time on Xe concentration was calculated for a thermal base of 1500°F. (auth)

11194 (DC-55-11-17) EVALUATION OF FULL-LENGTH HTRE-Al CARTRIDGES TESTED IN ANP BURNER RIG. G. T. Muehlenkamp (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 31, 1955. Contract AT(11-1)-171. 17p.

The results obtained from the visual and metallographic examination of the second and third full-length HTRE-Al cartridges after operation in the GE-ANP burner rig facilities are presented. The extent of damage to the stages and rings comprising these cartridges is given. Evaluation of the condition of these cartridges after burner rig testing with respect to operation in the reactor was difficult due to the non-uniformity of the indicated temperatures and the unknown composition of the atmosphere encountered in the burner rig. The results of metallographic examination revealed some areas for improvement in the quality of the elements. Conclusions and recommendations are given. (auth)

11195 (DC-55-12-110) THE USE OF DEPLETED URANIUM IN THE AC-110 SHIELD. Miles J. Todd (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 21, 1955. Contract AT(11-1)-171. 18p.

Depleted uranium was proposed as the dense shielding material for the AC110 powerplant. The results of a literature search and discussions with personnel at Hanford regarding the use of this material indicated that dimensional instability under thermal cycling at elevated temperatures is such that its use does not appear very promising at this time. Other dense shielding materials, some of which may prove more satisfactory than depleted uranium, are briefly described. (auth)

11196 (DC-56-12-37) SOLID MODERATOR DEVELOPMENT–MILESTONE D. EVALUATION OF CLAD HYDRIDED ZIRCONIUM AS SOLID MODERATOR. C. L. Huffine (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 29, 1956. Contract AT(11-1)-171. 42p.

Results are summarized of evaluation testing of small-scale specimens of clad hydrided zirconium to determine feasibility of use as solid moderator in militarily useful aircraft reactors. Included are results of static thermal tests, gradient thermal tests, cyclic thermal tests, and radiation damage tests. In general, results were encouraging and no serious deterrent to the proposed use of the material was found. (auth)

11197 (DC-57-1-95) PRELIMINARY REPORT ON THERMOCOUPLES FOR FUEL ELEMENT PLATE TEMPERATURE AND CONTROL. W. C. Kuhlman and J. W. Glasgow (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 16, 1957. Contract AT(11-1)-171. 17p.

The development of sheathed thermocouple materials and techniques for applying them to fuel cartridges is described. Sheath material tests were made which indicate that Pt–20% Rh, Inconel, and Nichrome V would be satisfactory. Methods for making the junctions with fuel elements are described. The development of air couples for control purposes is discussed. (D.L.C.)

11198 (DC-57-9-32) EFFECT OF SURFACE OXIDATION OF FUEL ELEMENTS ON PRESSURE LOSS. B. A. Chandler, P. E. Reis, and J. Holowach (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 21, 1957. Contract AT(11-1)-171. 16p.

Experimental flow studies of Nichrome concentric ring fuel elements indicated that a pressure loss increase of 10% during a structural test at operating temperature may be wholly the result of increasing surface roughness due to oxidation. Studies were made on three specimens which were subjected to high temperature structural tests in the burner rig and on an artifically roughened (sandblasted) element. (auth)

11199 (DC-57-9-107) THE DESIGN OF THE HTRE-3 AUTOMATIC CONTROL. Robert I. Emmert (General Elec-

tric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Sept. 12, 1957. Contract AT(11-1)-171. 93p.

The design of the feedback control loops in the reactor control system for the HTRE-3 reactor is presented. The status of the control is given at the end of theoretical design, computer simulation, and test operation. The items discussed include the dynamic rod position loop, the power range flux control loop, the intermediate range flux control loop, and the temperature control loop. The final result is the closed loop transfer functions of the above mentioned loops in analytical form. (auth)

11200 (DC-57-11-176) TUBE BUNDLE CALCULATIONS. J. McCurdy (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 22, 1957. Contract AT(11-1)-171. 35p.

The digital technique for computing the distribution of weight flow in each tube in a bundle of tubes as a percentage of the average weight flow for one tube in the tube bundle and the pressure levels throughout each tube is presented. The computations are based upon equations which are given. (auth)

11201 (DC-58-1-1) PROGRESS REPORT-FUEL ELEMENT TASK FORCE APPLIED MATERIALS RESEARCH. P. K. Conn, P. W. Davis, G. L. Hammons, F. C. Robertshaw, and M. A. Strauss (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 31, 1957. Contract AT(11-1)-171. 52p.

Studies in support of the development of Fe-Cr-Al-clad Nb-UO_2 core fuel ribbons are described. The work centers primarily on the following areas: (1) mechanism of ribbon failure under thermal cycling conditions, (2) formation of uranium metal in the core and diffusion to the cladding, (3) compatibility of ribbon components, (4) coatings for increased oxidation resistance of the ribbon, and (5) alternate approaches to hardware and over-all fuel element design. (D.L.C.)

11202 (DC-59-1-153) FRICTION FACTOR IN FUEL ELEMENT CARTRIDGE. J. C. Chu (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 12, 1959. Contract AT(11-1)-171. 26p.

An alternate method of correlating fuel element pressure drop is considered. The conclusion reached is that this method appears to be about as accurate but somewhat less easily applied than the original friction factor multiplier concept. Consequently the friction factor multiplier approach will still be used for pressure drop correlation and computation. (auth)

11203 (DC 59-10-707) DATA RESULTS FROM LPT NO. 3-4 AND LPT NO. 3-5. S. W. Gabriel, G. R. Lewis, and L. S. Masson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 1, 1959. Contract AT(11-1)-171. 102p.

The critical experiment results from LPT #3-4 and #3-5 are presented. The mockup HTRE #2 reactor was used as the parent core. Power distribution measurements, rod calibrations, and gamma dose rate measurements were made on inserts L1F, L1C, and on three modified parent core fuel cartridges placed in tubes 6, 11, and 29 of the parent core. The experiments were carried out at LPT during the period from March 19, 1959 to May 12, 1959. (auth)

11204 (DC 59-10-749) POST-OPERATIONAL EXAMINATION OF ANP-1CR2B: GAMMA SCANNING AND BURN-UP ANALYSES. L. L. Reed (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 21, 1959. Contract AT(11-1)-171. 8p.

Absolute disintegration rates of Zr^{95} were determined for three positions on five fueled tubes and one position on two fueled tubes from ANP-1CR2B. Radiochemical separations for Zr^{95}, Cs^{137}, and Ce^{144}, and total uranium on one of the tubes allow the calculation of percent burnup. The percent burnup on all tubes as calculated from the gamma scanning data averaged 0.94%. (auth)

11205 (DC 59-11-3) PRELIMINARY EVALUATION OF A PROPOSED FUEL MATERIAL FOR HIGH TEMPERATURE REACTORS. E. F. Juenke (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 28, 1959. Contract AT(11-1)-171. 5p.

Results are reported for preliminary experiments to determine the stability of solid solutions of UO_2 and ThO_2 in air at temperatures of 2500°F and above. The results are compared with those obtained by workers at Argonne during development work on the Borax IV experimental breeder reactor. It is concluded that further evaluation of the system at temperatures above 2500°F is required. (auth)

11206 (DC-59-11-85) DIGITAL ANALYSIS OF FISSION PRODUCT BUILDUP AND DECAY-EA PROBLEM NO. 7-1156-ANP PROGRAM NO. 153-TASK 433211-JOB NO. 51446. J. A. Delaney (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 3, 1959. Contract AT(11-1)-171. 61p.

The ANP 704 Digital Program No. 153 computes the concentration of a particular radioactive isotope at time t due to radioactive buildup and decay of fission products. From this value is calculated the final answer of the program, the percentage escape rate. Times are given by specifying the dates and time of day when the particular phases of the test were completed. A general solution for the differential equation $da_i/dt + \lambda_i a_i = Y_i + \lambda_{i-1} a_{i-1}$ is presented in a convenient form for digital computer computation. (auth)

11207 (DC-60-2-22) ASSEMBLY, INSTALLATION, OPERATION AND CONTROL INSTRUCTIONS FOR D103A NUCLEAR SENSORS. R. R. Swope (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 15, 1960. Contracts AT(11-1)-171 and AF 33(600)-38062. 89p.

A description is presented of the assembly, installation, operation, and control of the D103 power plant nuclear sensors. (J.R.D.)

11208 (DC-60-2-84) PREDICTED RADIAL TEMPERATURE DISTRIBUTIONS FROM TRANSIENT TEMPERATURE MEASUREMENTS IN A HOLLOW BeO CYLINDER. J. E. Stankevicz and R. N. Noyes (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 3, 1960. Contract AT(11-1)-171. 15p.

Results of cooling tests conducted on a hollow BeO cylinder are presented. This tube was heated on the outside by thermal radiation from surrounding lamps, and cooled by a constant air-flow rate through the center hole. Thermocouples were embedded in the tube-wall thickness at three different axial positions along the tube. The test procedure was to allow the sample to come to equilibrium temperature with the lamps on and no air flow, and then turn on the air flow (with the lamps still on) and observe the temperature-time history of each of the three thermocouples during the cooling process. The purpose of these tests was to obtain experimental data from which stress levels within the BeO cylinder could be obtained. As a necessary intermediate step in the final determination of the stress pattern, an analysis was made to determine the radial variation of temperature within the tube wall material as a function of time. (auth)

11209 (DC-60-3-124) VIBRATION ANALYSIS OF P-103 SHIM SCRAM CONTROL ROD SYSTEM. H. A. Eagle and F. D. Krieger (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 15, 1960. Contract AT(11-1)-171. 88p.

Results of the analytical and experimental vibration investigations concerning the P-103 Shim-Scram Control Rod System are presented. Resonant frequencies of the system predicted by the analytical study were correlated with the experimental results. A report of the experimental test is included. (auth)

11210 (DC-60-4-22) INTERIM REPORT ON HTRE NO. 3 THERMODYNAMIC DATA. W. C Powell and A. W. Ratliff (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 31, 1960. Contract AT(11-1)-171. 61p.

Data are presented which were taken during the Phase II testing of HTRE No. 3 after an endurance run of 127 hr at 33 Mw with a turbine inlet temperature of 1330°F, 65 hr of the run being continuous. Interpretations of the data and comparisons with predictions are given. (D.L.C.)

11211 (DC 60-4-63) REPORT ON CURVED-TUBE PUSH-PULL CONTROL FOR 1000°F OPERATION. J. L. DeWeese (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 1960. Contract AT(11-1)-171. 19p.

Requirements are given for a workable push-pull control system using flexible push rods. The design philosophy of the curved-tube push-pull control system is discussed and test data on this system which verify this philosophy are given. (auth)

11212 (DC-60-4-174) NUCLEAR REACTOR CONTROL SENSORS. A SURVEY OF COMMERCIALLY AVAILABLE NEUTRON DETECTORS FOR POSSIBLE APPLICATION TO ANP CONTROL SYSTEMS. K. W. Arnold (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 28, 1960. Contract AT(11-1)-171. 31p.

Fundamental principles of operation, commercial availability, and development information applicable to neutron sensors used with reactor control systems are presented. (auth)

11213 (DC 60-6-53) CONTROL ROD POISON TIP MATERIALS DEVELOPMENT FOR HTRE NO. 3. W. G. Baxter, V. L. Gelezunas, and J. R. Miller (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 6, 1960. Contract AT(11-1)-171. 27p.

In the HTRE #3, the control rod poison tips are required to operate at 1650°F for 300 hours, withstand thermal and mechanical shock, have a worth of 0.18 $\Delta K/K$ in a rod 20 in. long and 0.7 in. diameter and be capable of operating in a distorted guide tube (due to reactor-shield misalignment and differential thermal expansion). To meet these criteria, the poison tip developed consists of five four-inch cylindrical segments of 42 wt % Eu_2O_3–58 wt % Ni core material clad with special low Si nichrome and joined together by Inconel X bearing straps. The development evolution leading to these materials and the "hydrostatic pressing" process used in their fabrication is described. (auth)

11214 (DC-60-6-735) PRELIMINARY DATA REPORT IET TEST SERIES NO. 18 PHASE II TESTING OF THE D102A2 POWER PLANT. J. W. Highberg, K. J. Skow, R. F. Brenton, J. F. Kunze, D. A. McKenzie, C. B. Cannon, C. Davidson, and A. F. Clark (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 17, 1960. Contract AT(11-1)-171. 288p.

The preliminary test data resulting from the testing of the D102A2 power plant in the Initial Engine Test Facility at the Idaho Test Station for the period from December 23, 1959 to February 8, 1960, are presented. (auth)

11215 (DC 60-7-31) DIRECT CYCLE NUCLEAR POWER PLANT STABILITY ANALYSIS. D. Buden and R. F. Miller (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 6, 1960. Contract AT(11-1)-171. 30p.

A power plant with a nuclear reactor substituted for the conventional chemical interburners in a jet engine is analyzed for stability. No longer is the instantaneous power generated by the heat source the same as the instantaneous power delivered to the turbine. A mathematical criteria is developed and tested using HTRE-3 data. The analytical results indicate at high operating speeds, the power plant is stable, but a region of instability exists at lower speeds. Power plant test at the Idaho Test Station verifies the analysis. Methods for controlling the power plant in the region of instability are discussed. The use of a high response speed control will act to stabilize the power plant. (auth)

11216 (DCL-60-1-73) POST-IRRADIATION METALLOGRAPHIC ANALYSIS OF MTR-GE-ANP-1V1 AND 1Y1. W. V. Ketron (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 17, 1959. Contract AT(11-1)-171. 19p.

Data obtained in a microscopic analysis of these two samples are presented. The samples were identical corrugated Ni–Cr alloy type experimental fuel elements. Results are described and shown in plates. (J.R.D.)

11217 (DLCS-1470107) DETERMINATION OF REACTOR COOLANT SYSTEM PRESSURE DROP. CORE I, SEED 3. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 25, 1962. Contract [AT(11-1)-292]. 22p.

Tests were conducted to evaluate the pressure drop and flow characteristics of the reactor coolant system during the lifetime of the station. The high-speed performance characteristics for all four coolant pumps compare closely with specifications. The total pressure drop for the 1A loop was below that of the 1B loop during high-speed operation, while the total loop pressure drops agreed closely with the predicted curves for low-speed operation. (B.O.G.)

11218 (DLCS-3590601) 1D MAIN COOLANT PUMP (ALLIS-CHALMERS NO. 80) POWER SUPPLY CHECK. Test Evaluation. Section 6. (Duquesne Light Co., Shippingport, Penna.). First issue, Aug. 22, 1961. Second issue, February 12, 1962. 39p.

Tests were carried out to determine the operating characteristics of the 1D 2400-volt bus under various load conditions. The data indicated that the three-phase voltage was balanced during the five different bus load conditions and dropped from a no-load voltage of 2400 ± 50 volts to 2300 ± 50 volts under the worst load conditions. The voltage dropped to a minimum of 2200 ± 50 volts during the time the 1D pump was accelerating to operating speed. Test data also indicated that the 1D 2400-volt bus three-phase currents and voltage were balanced and had sufficient capacity to start the 1D reactor coolant pump under the most adverse bus load conditions. (M.C.G.)

11219 (DLCS-4000201) AUTOMATIC DATA LOGGING AND COMPUTING SYSTEM SIMULATED OPERATING TEST. CORE I, SEED 2. Test Evaluation. Section 2. (Duquesne Light Co., Shippingport, Penna.). First issue, Feb. 9, 1962. Contract [AT(11-1)-292]. 22p.

Tests were made to check the adequacy and completeness of the logging program for the Automatic Data Logging and

Computing System and the ability of the system to measure core flows and temperatures with existing transducers. The thermocouple reference junction box temperatures as measured were found to vary from ±0.2 to ±0.4°F from the design 150°F. The computer successfully performed all the necessary program operations on all the input signals with two exceptions. The linearity tests were completed successfully for all points. (D.L.C.)

11220 (DP-695) HEAVY WATER MODERATED POWER REACTORS. Progress Report, December 1961. R. R. Hood, comp. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Jan. 1962. Contract AT(07-2)-1. 26p.

Hydraulic tests with light water in the main D_2O system of the Heavy Water Components Test Reactor (HWCTR) continued satisfactorily. Final preparations were made for charging D_2O into the reactor system. Fabrication was completed on six pairs of Zircaloy-clad inner and outer thin-walled tubes of uranium metal for tests in the HWCTR. The first data obtained from examination of a swaged uranium oxide tube that was irradiated at Savannah River indicated that process steps incorporated in the fabrication of the tube were effective in preventing localized hydriding of the Zircaloy sheath. Two compacted tubes of uranium oxide reached a burnup of 600 MWD/T in the Vallecitos Boiling Water Reactor without incident. Initial data were obtained at the Savannah River Laboratory on heat transfer burnout of tubes cooled by boiling water at 500 to 1000 psia. (auth)

11221 (GA-2493) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR. RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for period ending June 30, 1961. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-314. 219p.

The process for preparation of (Th, U)C_2 particles for fuel compacts was scaled up to batch size of 1300 g. Theoretical yields are higher than 99%, and 99% of the particles produced in 1300-g batches are in the correct size range. Data on irradiation of low-permeability graphites indicate a high neutron-induced contraction which seems to be temperature dependent. Samples of graphite expected to exhibit greater stability are currently being irradiated. Several phases of the physics and nuclear-analysis work were completed. The thermal-neutron spectrum measurements and development of a new analytic thermalization model were completed and were shown to be in agreement. The one- and two-dimensional life study codes, FEVER and DDB became available during the quarter, and FEVER was used for radial and axial burnup studies. A combination heat-transfer and kinetics code, BLOOST, was completed which is used in calculation of the temperature distribution in fuel elements and coolant streams after reactivity excursions. Preliminary determinations of fuel, Th, and poison loadings and a control-rod sequence were made. Kinetics calculations and the temperature-coefficient analysis were also completed for the preliminary design. Completed measurements of the Doppler effect by reactivity are reported for compacts with 26.5, 30, and 40 wt. % U-Th loadings in which an accuracy of about 10% was achieved. An activation method utilizing the V subtraction technique was also successfully applied to preliminary Doppler effect measurements. Analog calculations for transient reactor temperatures after loss of primary coolant circulation showed that this system provides adequate protection for the pressure vessel. Completion of the components for the prototype control-rod and drive system is reported. A process flow diagram was prepared for the fission-product trapping system consisting of room-temperature charcoal separators, and liquid-N cooled absorbers located on bypass-streams. Linear accelerator runs to measure the steady-state Kr and Xe release were completed and considerable effort was devoted to analysis of postulated accidents. (J.R.D.)

11222 (GEAP-3528(Rev.1)) AUTOMATIC CONTROL OF T7 TANKER BOILING WATER REACTOR PROPULSION SYSTEM. PRELIMINARY DESIGN AND ECONOMIC EVALUATION. R. B. Rice and J. I. Owens (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.) and W. M. Gaines, R. C. Larsen, and R. J. Noorda (General Electric Co. Computer Dept., Phoenix, Ariz.). Sept. 1, 1960. Contract AT(04-3)-189. 155p.

The results of a technical and economic analysis of automatic propulsion system control as a possible design improvement in the direct cycle boiling water reactor propulsion system in a T7 tanker are presented. The technical feasibility of attaining a completely automated marine boiling water propulsion system was determined. Economic incentives for automation were evaluated. A program of design and development is defined. (M.C.G.)

11223 (GEAP-3796) DESIGN, FABRICATION, AND IRRADIATION OF SUPERHEAT FUEL ELEMENT SH-4B IN VBWR. C. N. Spalaris, R. F. Boyle, T. F. Evans, and E. L. Esch (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 1, 1961. Contract AT(04-3)-189. 73p.

The design, fabrication, and irradiation results are described for a 0.028-inch thick 304 stainless clad fuel element (SH-4B) exposed in the Vallecitos Boiling Water Reactor loop under superheat conditions. During the exposure, a maximum steam temperature of 900°F was obtained, or 350°F superheat. The fuel element was removed due to the occurrence of a defect and the subsequent release of activity in the loop. Post-irradiation examination revealed stress corrosion cracking was responsible for the jacket failure, presumably from a combination of abnormally high water seepage in the loop and chloride ion concentration during reactor exposure. As a result of this test, information was obtained which will be helpful in establishing superheat fuel design criteria. (auth)

11224 (HPR-14) H.B.W.R. QUARTERLY PROGRESS REPORT, APRIL TO JUNE 1961. (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). Nov. 17, 1961. 66p.

First charge operation ended and plant modification for the second charge began on April 29th. The total first charge exposure was 1906 Mwh (11.2 Mwd/tonne). No fuel or major equipment failed and heavy water losses were negligible. There has been no measurable release of activity in exhaust air or sewage water and shutdown radiation levels in the hall were less than 10 mrem/hr 10 minutes after shutdown. During the period from October 1960 to final shutdown 47 unplanned automatic shutdowns occurred, with 32 attributed to minor equipment failure. The recombination system kept D_2 concentration within limits with an average D_2 production rate of 1.5 gram moles/Mwh. Average D_2O conductivity was kept below 1 μmho/cc by the purification circuit. Post shutdown examinations of fuel and equipment revealed no important corrosion although some slight pitting was observed in the feedwater tank. The first charge dynamic experiment results were successfully completed with the step reactivity and noise measurements. The comparison of experimental results with the model predictions is proceeding. Experimental transfer functions

and system responses to nonsinusoidal perturbations are presented. Power-void reactivity coefficients have been corrected for temperature effects and ranged from 82 to 90 pcm/Mw, depending on mode of operation. Eighty of the 100 second charge fuel elements have been delivered to Norway. Forty are at the NORA reactor at the Kjeller Research Center for critical experiments. Predelivery tests of second charge elements in the Swedish RO reactor showed less than 1% variation in reactivity worth among 25 elements tested. The material buckling measured in the Swedish ZEBRA exponential facility was 15.96 m^{-2} for an average second charge element, and agreed within 4% of prediction. Modification began with the draining and storage of heavy water on the first week of May and the removal of unnecessary piping and equipment from the first charge is proceeding on schedule. The designs of major equipment and circuits for the second charge primary, secondary, and tertiary coolant systems are complete. The new radiolytic gas recombination systems will have a capacity of more than 100 gram moles of D_2 per hour. The new 10 Mw primary steam transformer will employ a single rolled and welded tube sheet design rather than the double tube sheet originally specified. (auth)

11225 (HPR-16) PROCEEDINGS OF THE BOILING WATER REACTOR IN-CORE INSTRUMENTATION MEETING AT HALDEN (MAY 15-18, 1961). R. W. Bowring, ed. (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). Dec. 1961. 47p.

A summary of contributions to a discussion on in-core instrumentation for water-cooled reactors with emphasis on boiling reactors is presented. Discussions are included on instrumentation for measurement of temperature, void fractions, flow, flux, and water level. A short discussion is also included on fuel failure location techniques. (J.R.D.)

11226 (HW-67792) EXPERIMENTAL EVALUATION OF THE COMBUSTION HAZARD TO THE EXPERIMENTAL GAS-COOLED REACTOR-PRELIMINARY BURNING RIG EXPERIMENTS. R. E. Dahl (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1961. Contract AT(45-1)-1350. 45p.

An assembly was constructed which simulated the moderator coolant annulus in the Experimental Gas-Cooled Reactor. This assembly was preheated to various temperatures and air was passed through the coolant annulus. Under certain conditions it was demonstrated that self-sustained combustion of the graphite could occur. Rates of temperature rise were generally less than 1°C/min until the graphite temperature exceeded 700°C and then rise rates became very high. In these experiments, the assembly was not operated in such a manner as to give ignition temperatures characteristic of the EGCR. These tests were designed only to investigate the effects of changing such parameters as the rate of coolant flow, air humidity, prior oxidation on the graphite, and air inlet temperature. A later series of experiments to more closely duplicate the EGCR operating conditions was completed and will be reported in a second report, HW-71182. (auth)

11227 (HW-71279) THE USE OF "PHOENIX" FUEL FOR COMPACT POWER REACTORS. P. L. Hofmann and G. J. Busselman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 9, 1961. Contract AT(45-1)-1350. 21p.

An investigation was carried out to study the possible use of various plutonium isotope compositions in compact power reactors. The forced circulation, pressurized water unit design was studied. The reactivity time variation was calculated along with reactivity temperature coefficients. The use of highly recycled Pu, rich in Pu^{240}, did not appear to solve the problem of large reactivity mismatches in long-endurance, high power density compact reactors. Such reactors require high initial reactivities and thus U^{235} must be added to offset the adverse effects of Pu^{240}. The resulting reactivity-time behavior of such cores was very similar to that of U^{235}-unshielded burnable poison systems characterized by pronounced reactivity mismatches. (M.C.G.)

11228 (HW-72679) HANFORD STUDIES EXECUTED FOR THE USAEC-AECL COOPERATIVE PROGRAM ON DEVELOPMENT OF HEAVY WATER MODERATED POWER REACTORS. Monthly Progress Report, January 1962. S. Goldsmith, comp. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 14, 1962. Contract [AT(45-1)-1356].

In heat transfer and fluid flow studies, plans for use of the 0.015-in. spaced 19-rod bundle were completed. Fabrication of the test section was started and the design for installation of thermocouples in the 0.074- and 0.015-in. spaced test sections was completed. Studies of comparative ultrasonic signal strengths for various test angles were continued. Data on ultrasonic response from reference notch measurements is included. The transducer response measurements using the small ball-bearing technique are about 75% complete. Elevated temperature tensile tests on SAP closure welds are reported in which ultimate stresses obtained were 38,200 psi at room temperature, 29,200 psi at 200°C, and 12,700 psi at 400°C. (J.R.D.)

11229 (MND-MD-2560-1) PM RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report No. 1, April 15, 1961–June 30, 1961. R. L. Baer (Martin Co. Nuclear Div., Baltimore). Contract AT(30-1)-2706. 75p.

Work accomplished on the PM research and development program is reported. Core design development, plant design development, fuel element and core component development, critical experiments and zero power testing, reactor flow tests, and heat transfer tests are discussed. (M.C.G.)

11230 (MND-MD-2560-3) PM RESEARCH AND DEVELOPMENT PROGRAM. Third Quarterly Progress Report, October 1, 1961 to December 30, 1961. R. L. Baer (Martin Co. Nuclear Div., Baltimore). [Feb. 1962]. Contract AT(30-1)-2706. 141p.

Work accomplished on the Army Reactor PM research and development program is reported under the following topics: core design development, plant design development, fuel element and core component development, critical experiments and zero power testing, reactor flow tests, and heat transfer tests. (M.C.G.)

11231 (NAA-SR-6527) MULTI-CHANNEL BOILING STABILITY FOR SODIUM GRAPHITE REACTORS. H. H. Cappel (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 1, 1962. Contract AT(11-1)-GEN-8. 36p.

An analysis of coolant boiling in sodium graphite reactors is presented. Boiling interactions and hydraulic stability as affected by boiling progagation are discussed and analyzed in relation to the ultimate shutdown concept of SGR systems. A ramp reactivity excursion simulated for a three-channel model and a seven-channel reactor model, is studied for the various effects. The results show the interactions between channels to be of minor importance as affecting reactivity feedback. Propagation of boiling in particular, is significant only for a limited range of coolant temperature conditions; this propagating effect never-

theless is sufficiently large to make stable boiling for this reactor system unlikely. (auth)

11232 (NAA-SR-6616) AN EMPIRICAL PREDICTION OF TEMPERATURE GRADIENTS IN MODERATOR GRAPHITE WITHIN OPERATING NUCLEAR REACTORS. Robert L. Carter (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 15, 1962. Contract AT(11-1)-GEN-8. 50p.

The thermal conductivity of artificial graphite as a function of temperature, integrated fast neutron irradiation experience, and temperature during irradiation was deduced by a semi-empirical procedure. Within a section of circular symmetry centered upon a fuel element of a graphite-moderated reactor core, the volume heat generation by gamma and neutron degradation were estimated as a function of a single radial position variable. Assuming the heat flow from the graphite moderator volume to be entirely radial, self-consistent calculations were made for temperature distributions at various positions within the reactor core at various times after reactor startup. Results are given for the Sodium Reactor Experiment (SRE), for a calandria-core 255 Mwe SGR, and for the reactor at the Hallam Nuclear Power Facility. (auth)

11233 (NMI-7242) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission, for the period August 1, 1961 through August 31, 1961. S. Isserow, R. W. Anderson, W. J. Richmond, and E. F. Jordan (Nuclear Metals, Inc., Concord, Mass.). Oct. 5, 1961. Contract AT(30-1)-1565. 19p.

The improved demonstration set of three unalloyed outer U tubes was evaluated and met specifications for irradiation candidates. Two 2-in. tubes with 60-mil nominal cladding were extruded for use in studying the effects of restraint on fuel during irradiation. Processing of a 1-in. tube and two earlier 2-in. tubes is almost complete. An outer tube billet composed of U-1 wt % Si stalled during extrusion but a U-0.3 wt % Al-0.5 wt % Si was successfully extruded. (J.R.D.)

11234 (ORNL-3231) ARMY REACTORS PROGRAM PROGRESS REPORT. (Oak Ridge National Lab., Tenn.). Feb. 14, 1962. Contract W-7405-Eng-26. 50p.

Research and development on metallurgical aspects of pressurized-water systems is summarized. A survey was made of the methods of determining fuel burnup. The mechanisms and kinetics of the loss of boron during heating at 1135°C in various dynamic environments were determined. A model was developed to quantitatively characterize the UO_2 dispersion microstructure of roll-clad fuel plates relative to an "ideal" dispersion. In order to avoid the loss of boron from UO_2–stainless steel dispersion fuel plates during fabrication, studies were carried out on a refractory glass containing 4 wt.% B_2O_3. By using low-silicon elemental powder, the undesirable reaction between Eu_2O_3 and Si was eliminated; and 13 full-size SM-1 absorbers were fabricated. Work was continued on the boron-gradient neutron absorber concept. A design was studied for preparing a composite control rod having an upper section made of a boron-gradient dispersion and the lower tip made of Eu_2O_3 and stainless steel. Two fuel elements were examined after significant exposure in SM-1. The examination of the miniature boron-iron samples in the final phase of the MTR irradiation test was performed. Twelve miniature test specimens containing 20, 30, or 40 wt.% Eu_2O_3 were placed in the ETR for test. No defects were found in a control rod rack of 17-4 PH stainless steel removed after 3 years of operation in the SM-1. (M.C.G.)

11235 (ORNL-3249) EVALUATION OF THE BORON CONTENT IN FUEL PLATES FABRICATED FOR THE FIRST CORE LOADING OF THE ARMY SM-1 REACTOR (FORMERLY APPR-1). J. H. Cherubini, C. F. Leitten, Jr., and R. J. Beaver (Oak Ridge National Lab., Tenn.). Feb. 23, 1962. Contract W-7405-Eng-26. 24p.

The austenitic stainless steel-clad plate-type fuel element used in the SM-1 reactor contains a dispersion of 25.16 wt % UO_2 and 0.13 wt % B_4C dispersed in type 302B stainless steel. Subsequent to fabrication of the first fuel element loading for this reactor, an investigation was conducted to determine the magnitude of boron losses which occurred during sintering of the powder metallurgically prepared fuel compacts. The objective in this case was to determine the total boron losses in the completely processed and finished fuel plate. This was done by dissolving fuel plates in their entirety and chemically analyzing for boron. The accuracy of the analytical methods used was first established by analyzing powder mixtures containing the exact quantities of UO_2, B_4C, and stainless steel representative of a fuel plate. A negative bias was shown to exist. The conclusion was that the accuracy of the analysis of boron in the SM-1 fuel plate was $^{+0}_{-10}$%. Subsequent dissolution of 18 plates and results of the boron analyses revealed losses ranging from 9 to 50%. The average boron loss in the Core I loading was estimated to be 22%. (auth)

11236 (ORNL-TM-106) SUMMARY OF HRT RUNS 22, 23 AND 24. H. F. Bauman, J. R. Buchanan, J. R. Engel, P. N. Haubenreich, and D. M. Richardson (Oak Ridge National Lab., Tenn.). Mar. 6, 1962. Contract W-7405-eng-26. 92p.

In runs 22, 23, and 24 the HRT was operated with downward flow through the core at powers up to 5 Mw. Because of leakage past the lower core tank patch, uranium could not be prevented from entering the blanket, so the concentration was deliberately kept above 1 g U/kg D_2O. The core power was about 0.6 of the total. Nuclear power fluctuations were larger than with upward core flow, and the cause was investigated intensively in run 22 at powers up to 1.8 Mw. Run 22 was terminated after 778 hours when a leak developed in a fuel feed pump weld. In run 23 the power was raised stepwise to 5 Mw. This run was terminated after 794 hours by the removal of the fuel, containing the fission and corrosion products accumulated in 10,028 hours of operation. Fuel replacement required three days. Run 24 operations were hampered by a leak which developed between the feed and letdown streams in the fuel letdown heat exchanger. The run was terminated after 546 hours, when a crack developed in a fuel feed line tee and leaked solution into the reactor cell. The changes in the core flow and heat transfer were evidently effective in eliminating regions of high temperatures and uranium deposition. In all the operations, including more than 100 hours at 5 Mw, there was never any indication of fuel instability. Previous operation at the same pressure (1400 psig) and core mean temperature had resulted in detectable instability at lower powers. (auth)

11237 (JPRS-12183) ARTICLES ON THE LENIN ICEBREAKER. Translation of Sudostroenie, No. 8, 11-14; 21-9; 30-8(Aug. 1961). 79p.

Four papers are included which discuss the radiation safety, power systems, and facilities of the Lenin icebreaker. Separate abstracts were prepared for all four papers. (D.L.C.)

11238 (JPRS-12183(p.1-10)) PROVIDING FOR RADIATION SAFETY ON THE "LENIN" ATOMIC ICE-BREAKER. A. I. Burnazyan, S. M. Gorodinskii (Gorodinskiy), I. D. Kamyshenko, Yu. G. Nefedov, and V. N. Pravetskii (Pravetskiy). Translated from Sudostroenie, No. 8, 11-14(Aug. 1961).

The radiation safety measures adopted for the icebreaker Lenin are described. The reactor system is located in a central compartment, and only these clad in special clothing may enter the central compartment. The procedures adopted in disposing of radioactive air and wastes are described briefly. Instrumentation for dosimetry is discussed. No trouble was encountered in the preliminary trials, and radiation levels in the central compartment did not exceed several tenths of the permissible levels. (D.L.C.)

11239 (JPRS-12183(p.11-34)) THE POWER SYSTEM OF THE "LENIN" ATOMIC ICEBREAKER. A. I. Brandaus and B. S. Yudovin. Translated from Sudostroenie, No. 8, 21-9(Aug. 1961).

The power system of the Lenin icebreaker is described in detail. Three nuclear reactors were installed on the icebreaker, two of which allow operation of the main turbines at ~80% of full load. Two autonomous turbo-generator power plants are provided to feed electric energy to the power system, and reserve diesel generators are to serve as emergency sources. An auxiliary boiler system is to provide the steam required for everyday services on the ship when the atomic steam-generating system is not operating. The layout of the mechanical system is given. The patterns of the steam-condensate cycle and of start-up and control are described. Test operations were successful. (D.L.C.)

11240 (JPRS-12183(p.35-54)) THE ELECTRIC POWER SYSTEM OF THE ICEBREAKER "LENIN." N. A. Agafonov. Translated from Sudostroenie, No. 8, 30-3 (Aug. 1961).

The power consumption on the Lenin icebreaker is outlined, and the design requirements of an electric power system are discussed. Measures for ensuring continuous power supply to critical components, e.g., the atomic steam generators, are described. Finally, control of the electric power system is discussed. (D.L.C.)

11241 (JPRS-12183(p.55-78)) DEVELOPMENTS IN THE FACILITIES OF THE ATOM-POWERED ICEBREAKER "LENIN." P. P. Berezin. Translated from Sudostroenie, No. 8, 34-8(Aug. 1961).

The following facilities developed for "Lenin" are discussed: liquid-supply systems (e.g., drinking, sewage), air-conditioning system, icebreaker systems, and systems serving the atomic reactor installation (decontamination and waste disposal). (D.L.C.)

11242 STABILITY IN THE LARGE OF HETEROGENEOUS POWER REACTORS. Henri B. Smets. Bull. classe sci., Acad. roy. Belg., (5) 47: 382-405(1961). (In English)

Liapounoff's second method is used for the determination of the conditions of stability of nuclear power reactors. The problem of a double lag power reactivity feedback is analyzed in detail. The stability properties of reactors with a positive and a negative power coefficient of reactivity, of boiling water reactors, and of reactors with xenon build-up are considered in the examples. (auth)

11243 EXPERIMENTS PRELIMINARY TO THE BUILDING OF THE REACTOR RAPSODIE. L. Vautrey and C. P. Zleski. Bull. inform. sci. et tech. (Paris), No. 57, 2-38(Dec. 1961). (In French)

The main tests preliminary to the construction of Rapsodie are described. These tests, mostly conducted on full-scale mockups, were designed to study the behavior of the various components and circuits under conditions as close as possible to actual operation. In addition, a number of tests were carried out in connection with hypothetical reactor accidents. (auth)

11244 BACKGROUND FACTORS TO THE DESIGN OF CONTROL EQUIPMENT FOR THE CIVIL NUCLEAR POWER STATIONS. R. D. Trotter (Central Electricity Generating Board, London). J. Brit. Inst. Radio Engrs., 22: 513-18(Dec. 1961).

The design of the control and indication facilities of a nuclear power station must be based on the methods of operation of the plant and its staffing. The first stations are expected to operate at very high load factors as base load stations for the transmission system. This criterion leads to station layouts designed to use the minimum of staff on day-to-day operation and to the use for each station of a central control room. The principles governing the design of equipment for the C.E.G.B. stations are outlined. (auth)

11245 DOUGLAS POINT. CANADA'S FIRST NUCLEAR POWER STATION. Nuclear Energy, 74-7(Feb. 1962).

The design, construction, operation, characteristics, and cost of the Douglas Point Nuclear Power Station are briefly described. The station will utilize a 200 Mw natural uranium fueled, heavy water cooled and moderated, horizontal pressure tube reactor with a heat output of 694 Mw (CANDU reactor). Particular emphasis is placed on the cost of the station and the costs involved are tabulated. The reactor is located at Douglas Point on the shore of Lake Huron near Kincardine, Ontario, Canada. (N.W.R.)

11246 LOOKING AHEAD AT PRESSURIZED-WATER REACTORS. William E. Shoupp (Westinghouse Electric Corp., Pittsburgh). Nucleonics, 20: No. 3, 47-52(Mar. 1962).

Recent advances in the development of closed-cycle pressurized water reactors will lead to reactors that produce secondary steam at twice the pressure of that supplied by present nuclear plants. The improvements being made to the fourth and fifth generations of closed-cycle reactors are discussed and described. The improvements are due to reduction of hot-channel factors and introduction of bulk boiling in the hot channel to increase heat transport per unit flow of primary coolant. This limited boiling also increases the average enthalpy in the hot leg and yields higher steam pressures and, consequently, improves efficiency and steam performance, requires minimum pumping power, and reduces fuel costs. These reductions in hot-channel factors are accomplished by a combination of core improvements: control-rod programming to ensure minimum peaking in flux and power over lifetime; three regions of enrichment loaded radially, with maximum enrichment in the outside region; fuel-bearing control-rod followers; and moderator shim control at power as a control shim. Other improvements are also mentioned for the fifth generation of pressurized water reactors. (N.W.R.)

11247 HEAT REMOVAL FROM GAS-COOLED POWER REACTORS. Dieter Smidt (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Ger.). Nukleonik, 3: 257-67(Nov. 1961). (In German)

The variables significant for the coolant engineering of power reactors are first summarized. With their help closed expressions for the reciprocal hydraulic diameter of the coolant channel and the relative circulating power are derived. These are so constructed that they can eval-

uate directly the effect of the individual variables on each other. For the geometric form of the coolant channel only very general assumptions need be made. The effect of different gases on the interpretation was investigated and traced back to the physical properties of the gases. For a frequently used case of the Nusselt equation for the heat transfer, the functions occurring in the calculations were represented graphically so that the necessary coolant engineering calculations could be carried out very rapidly for orienting investigations of an arbitrary design. (tr-auth)

11248 POWER REACTOR EXPERIMENTS. Proceedings of a Symposium, Vienna, 23-27 October, 1961. Proceedings Series. Vols. I and II. (International Atomic Energy Agency, Vienna). Jan. 1962. 687p. (STI/PUB-51 (Vols. I and II)). $6.00(Vol.I); $4.00(Vol.II). (IAEA).

Thirty-one papers presented at the Symposium on Power Reactor Experiments in Vienna, October 23 to 27, 1961, are given. Discussions of each paper are included. Twenty-two of the papers are in English, 6 in Russian, and 3 in French. Abstracts for each paper are given in French, English, Russian, and Spanish. Each paper was abstracted separately for NSA. (M.C.G.)

11249 RESEARCH AND DEVELOPMENT ASPECTS OF THE DRAGON REACTOR EXPERIMENT. L. R. Shepherd and P. J. Marien (Atomic Energy [Research] Establishment, Winfrith, [Eng.]). p.13-47 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1961. (In English)

Many problems which have arisen in connection with the design and construction of the DRAGON high-temperature reactor experiment and the research and development effort required to solve these are discussed. It is shown that the reactor experiment, when it is operating, will provide a useful tool for the further development of high-temperature reactors. (auth)

11250 ENGINEERING ASPECTS OF THE DRAGON REACTOR EXPERIMENT. G. E. Lockett (Atomic Energy [Research] Establishment, Winfrith, [Eng.]). p.49-78 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The broad aims and main design parameters of the DRAGON reactor are stated. They produce some interesting design problems and some design philosophies have evolved. They aim, as far as possible, to reduce the engineering problems to known proportions where minimum proving or development is required. The choice and positioning of components is of interest and a number of examples are given. A brief over-all description of the whole reactor plant is followed by a general description of the reactor itself, together with details of some of the components of special interest. (auth)

11251 EXPERIMENTAL BASES FOR THE DESIGN OF THE EBOR. W. C. Moore ([General Atomic Div.,] General Dynamics [Corp.,] San Diego, Calif.). p.79-101 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (GA-2477). (In English)

The Experimental Beryllium Oxide Reactor (EBOR) was designed to test fuel element and moderator module concepts applicable to the Maritime Gas-Cooled Reactor (MGCR) or to central station nuclear power generating stations in the 20 to 100 MW(e) size range. The reactor utilizes helium as a coolant, beryllium oxide as moderator, and Hastelloy-X clad ceramic pellets of UO_2–BeO mixtures as fuel elements. Although the present design limits the reactor power level to 10 MW(t), the use of a large pressure vessel will permit later up-grading to higher power levels (50 to 75 MW(t)). The energy generated will initially be dissipated to the atmosphere through a helium-air heat exchanger. However, the plant layout is arranged to facilitate coupling the reactor to a helium turbine subsequent to initial tests and up-grading. Construction of EBOR is scheduled for completion in March 1963 under United States Atomic Energy Commission auspices at the National Reactor Testing Station. General Dynamics/General Atomic Division is supplying the conceptual design, furnishing the key items of equipment required, and conducting supporting research and development. The supporting experimental program is discussed including construction and operation of a critical assembly, out-of-pile heat transfer tests, control rod drive tests, irradiation tests of BeO and BeO–UO_2 fuel pellets, and in-pile testing of fuel element sections. (auth)

11252 PEBBLE-BED REACTOR PROBLEMS TO BE INVESTIGATED IN A 10-MW(t) REACTOR EXPERIMENT. A. P. Fraas (Oak Ridge National Lab., Tenn.). p.103-24 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

An extensive series of design studies was carried out at ORNL to establish the more promising design features, the probable range of fuel cycle and construction costs, and the principal feasibility problems of both large-scale pebble-bed reactor power plants and small reactor experiments. These studies indicated that the major feasibility problems are associated with the operation and maintenance of a severely contaminated high-pressure gas system. It appears that a 10-MW(t) reactor experiment should be an effective means for investigating these problems which include the degree of leak-tightness obtainable with a contaminated gas system, fuel-handling and reactor maintenance procedures, the integrity of the fuel element, the nature and amount of fission products released from the fuel, the nature, composition, and distribution of fission-product deposits throughout the system, the extent to which the helium can be purified with filters, charcoal traps, molecular sieves, etc., and the extent to which components such as blowers can be decontaminated. The maintenance operations to be carried out in both the full-scale plants and a reactor experiment appear to be such that essentially similar facilities, equipment, techniques, shielding, and plant layout would be applicable to both cases. (auth)

11253 RHOMBOHEDRALLY PACKED PEBBLE BED REACTOR. Z. P. Zarić ("Boris Kidrich" Inst. of Nuclear Sciences, Belgrade). "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A conception of a gas cooled pebble bed reactor is described, based on a regular packing of pebbles in a space matrix, and a free flow area between the fuel bed and the moderator element walls, assured by the appropriate core design. By the regular packing of spheres and small cylinders with hemispherical ends of different diameters, with the possibility of the pebble bed voidage variations from 15 to 50%, the exact investigation of the local heat transfer and fluid flow conditions is made possible. This means that high factors of uncertainity associated with the random packing are greatly reduced. The free flow area between the fuel bed and the moderator elements enables the use of the high turbulent mixing in the bed for the energy transfer to the undisturbed portion of gas stream, with the correspondent reduction of pressure drop through the core. The combination of the two enables the optimal power distribution in the core to be achieved, followed by the appropriate coolant flow distribution. (auth)

11254 CONCEPT OF THE SEMI-HOMOGENEOUS REACTOR (SHR) AND PRESENT STATUS OF RESEARCH. E. E. Nishibori, R. Ueda, and T. Koroyanagi (Japan Atomic Energy Research Inst., Tokyo). p.149-54 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies are being made on high temperature gas cooled reactors using semi-homogeneous fuel composed of a mixture of uranium oxide (UO_2) or carbide (UC). The particular feature of the semi-homogeneous fuel conceived in the Japan Atomic Energy Research Institute is the idea of uniformly dispersing the natural graphite nuclear fuel material in the form of grains smaller than 5 μ to facilitate actively removing gaseous fission products from the fuel body, and thus improve neutron economy. Non-volatile fission products will be captured in the graphite, which will simplify reprocessing. Apart from the use of helium as coolant, there are plans also of using molten bismuth for this purpose. Studies are being pursued on the basic and engineering aspects of the reactor concept. (auth)

11255 IN-PILE MEASUREMENTS OF THE RELEASE OF FISSION PRODUCTS FROM URANIUM DIOXIDE IN A GRAPHITE MATRIX. F. Barth (Brown-Boveri/Krupp Reaktorbau G.m.b.H., Duesseldorf), C. B. von der Decken, A. Clauss, H. Reichel, and W. R. Ruston. p.155-70 of "Power Reactor Experiments. Vol. 1." Vienna, International Atomic Energy Agency, 1962. (In English)

Measurements of the release of fission products from matrix fuel are described. The test samples were pressed and sintered bodies made from a mixture of graphite and UO_2 powders. The fission product release was measured in a hot loop-experiment in the reactor BR 1. In this loop the samples were heated in the reactor by an electrical furnace to temperatures ranging from room temperature up to 1600°C. The helium gas in the circuit was analyzed for the fission products by separation of the different element groups and by γ-spectrometry. Results of the release of a number of different isotopes are given and a model for the mechanism is proposed. (auth)

11256 COMPARISON OF THE IRRADIATION BEHAVIOUR OF 1% PuO_2 IN UO_2 AND STOICHIOMETRIC UO_2. J. B. Sayers and J. H. Worth (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.171-83 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Uranium oxide slightly enriched with plutonium oxide is a possible fuel for advanced thermal reactors, and the results are given of a preliminary investigation into the irradiation behavior of such fuels. The UO_2 was produced by the ammonium diuranate (ADU) route and the UO_2/PuO_2 solid solution by co-precipitation from ADU$-Pu(OH)_4$ followed by reduction to UO_2PuO_2. The sintering conditions are outlined and the methods used to characterize the sintered pellets briefly described. The pellets were canned in stainless steel and the capsules irradiated in a pressurized water loop in the NRX reactor at AECL. The uranium enrichments were adjusted so that the comparative elements operated under similar conditions of surface temperature and rating. Irradiation levels in the range of 2000 to 3000 MWd/t were obtained at ratings of 25 to 35 W/g. Fuel center temperatures were in the range of 1700 to 2500°C. Post irradiation examination revealed that there was no substantial difference in the irradiation behavior of the two fuels. A precise comparison was not possible due to slight differences in the densities of the fabricated pellets, but measurements of the release of fission product gases were similar in both fuels and from measurements of the degree of grain growth no substantial changes in thermal conductivity are apparent. (auth)

11257 HYDRODYNAMICAL ASPECTS OF A HOMOGENEOUS SUSPENSION REACTOR. P. Novotný (Novatny) and V. Khamrad (Hamrad) (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Prague). p.187-95 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

Research was carried out, with a mock-up of the plant, on the hydrodynamics of the UO_2 suspension in HR-1, an aqueous homogeneous reactor. Experience acquired on the behavior of the suspension in various parts of the primary circuit led to the development of a new conception of the plant, designated HR-2. The basic principle of HR-2 is a compact arrangement in which movement of the suspension takes place only in the vertical plane, as a result of which precipitation of the solid phase is completely eliminated. The active zone, located in the lower part of the plant, consists of two co-axial components. The suspension flows downwards in the outer part and upwards in the inner part. Above the active zone it passes through centrifuge-separators of the radiolytic gas and the solid phase. Above the separators, the suspension flows through the inner part of the vertical steam generator into a circulating pump, situated at the top of the primary circuit. After passing through the pump, the suspension is returned downward through the outer part of the steam generator and falls into the outer part of the active zone. The plant is connected through a rapid-lifting valve with emergency storage vessels and provided with an emergency protection device. Hydrodynamic experiments were carried out on a mock-up of the HR-2 plant. (auth)

11258 PHYSICAL ASPECTS OF AN AQUEOUS HOMOGENEOUS SUSPENSION REACTOR. J. A. H. Kersten, J. J. Went, and J. J. van Zolingen (N. V. Kema, Arnhem, Netherlands). p.197-223 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

In a circulating suspension reactor it is important to determine the neutronic stability. In order to eliminate the stabilizing influence of the normally large negative temperature coefficient of reactivity, it was first desirable to investigate a zero energy or subcritical reactor. The influence of the colloid chemical stability of the suspension, the flow velocity, and the flow distribution inside the vessel on the neutronic stability, on the temperature coefficient of the system, as well as on the recoil separation efficiency of the fission products from the suspension particles is discussed. In particular an analysis is given of the neutron noise spectra of the reactor. Due to the observed high degree of stability of the reactor, fluctuations in k_{eff} can be made smaller than 0.01%, the reactor was used as a very sensitive concentration measuring device. Therefore, the reactor can be used for technological experiments. (auth)

11259 CHEMICAL ASPECTS OF AN AQUEOUS HOMOGENEOUS SUSPENSION REACTOR. M. E. A. Hermans, J. Kalshoven, J. Kuypers, T. Markestein, Th. van der Plas, H. S. G. Slooten, and R. G. Sowden (N. V. Kema, Arnhem, Netherlands). p.225-45 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Some typical chemical aspects in the development of KSTR (KEMA Suspension Test Reactor) at Arnhem (Netherlands) are discussed. Methods of preparation were developed for fuel powders consisting of spherical particles, 5 μ diameter. A method was found to measure the colloid chemical stability of aqueous suspensions of these

powders as a function of pH at temperatures up to 250°C without interaction of the wall of the container. The required stability of the fuel suspension could be attained. Recently, experiments were carried out to study the fuel behavior under irradiation. Under certain conditions deterioration of the fuel particles was found. Preliminary results of an investigation of this phenomenon are included. By measuring in a zero-energy assembly the retention of fission fragments in the fuel particles, the range of these fission fragments in UO_2 was determined. As it is intended to apply the fission recoil separation effect as a means of "continuous" purification of the fuel, the upper limit for the size of the fuel particles was established. The hydrolizable fission products are removed by adsorption onto a competing adsorbent and separation of this adsorbent from the fuel. Studies carried out on active charcoal as the adsorbent are described. (auth)

11260 THE MOLTEN-SALT REACTOR EXPERIMENT. A. L. Boch, E. S. Bettis, and W. B. McDonald (Oak Ridge National Lab., Tenn.). p.247-92 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The 10-Mw(t) Molten Salt Reactor Experiment has a graphite-moderated core approximating a right cylinder 54 in. in diameter and 66 in. high. A molten-salt fuel (composition $LiF-BeF_2-ZrF_4-ThF_4-UF_4$, 70-23-5-1-1 mole %) is circulated through channels in the graphite, then is pumped through the shell side of a heat exchanger at a maximum temperature and pressure of 1225°F and 50 psi, respectively, and returned to the core to complete the circuit. Heat is exchanged to a coolant salt, which is pumped through the tubes of the heat exchanger, and through a salt-to-air radiation where the heat is discharged to the atmosphere. All portions of the reactor in contact with the salts are fabricated from INOR-8, a nickel-base alloy containing 17 wt % molybdenum, 7 wt % chromium and 5 wt % iron; this alloy was developed specifically to contain molten salts. Replacement of major components will be accomplished by means of remotely-operated cranes, manipulators, and miscellaneous tools—all controlled from a shielded cubicle with direct viewing possible and indirect viewing accomplished by means of TV equipment. The development programs for the reactor components, materials of construction, and remote maintenance facilities are discussed. (auth)

11261 THE DOUNREAY FAST BREEDER REACTOR EXPERIMENT. J. L. Phillips and A. G. Frame (Dounreay Experimental Reactor Establishment, Caithness, Scotland). p.295-315 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The fast breeder reactor concept was part of the British nuclear reactor development program as early as 1953. The reasons for considering the concept at such an early stage in reactor development are mentioned, and the role of the fast reactor is discussed. A brief description of the Dounreay Fast Reactor and the philosophy behind the choice of the main design features are given. Modifications carried out on the reactor because of the entrainment of blanket nitrogen gas into the circulating liquid metal and the presence of unexpectedly high levels of impurities, such as oxides and hydrides, in the coolant are described and discussed. In addition, experience gained on the interaction between impurities in the sodium and the structural and canning materials, both in rigs and on the reactor, is disclosed. The future program and utilization of the reactor is outlined, use of the reactor as a fast reactor fuel element test bed and as a facility for investigating the kinetic behavior of fast reactor cores is discussed. Lessons learned from the reactor are summarized and possible developments and trends in design as a result of operational experience, are suggested. (auth)

11262 EXPERIMENTAL FAST OXIDE REACTOR. M. J. McNelly, K. P. Cohen, and B. Wolfe (General Electric Co., San Jose, Calif.). p.317-43 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The experimental fast oxide reactor (EFOR) is a 10-Mw(t) liquid metal-cooled unit proposed for construction by the USAEC at the National testing station in Idaho. The purpose of this facility is to demonstrate experimentally operating characteristics of ceramic fueled fast reactors. The potential of such systems resulting from the high burnup capability of ceramic fuel in fast cores with internal breeding was identified in studied by GE for the USAEC over the past two years. In small metal fueled fast reactors a prompt negative power coefficient is furnished by thermal expansion of the fuel. This cannot be relied upon in ceramic fueled reactors, particularly in large cores (3000 liters) necessary for large power outputs. It was, however, found possible to design large low leakage oxide fueled fast reactors which have high core conversion ratios and over-riding negative power coefficients due to the Doppler effect. The EFOR facility is designed to reproduce the fuel and coolant temperature profiles and a neutron spectrum representative of full-scale plants in order to demonstrate their postulated nuclear characteristics. Operation of the facility will enable this information to be obtained together with a demonstration of the effectiveness of the Doppler coefficient in severe transients, prior to construction of a large reactor of this type. (auth)

11263 FUEL CYCLES IN FAST REACTORS. S. A. Hasnain (Pakistan Atomic Energy Commission, Karachi). p.345-51 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A discussion is presented of some of the problems in the development of fuel cycles for fast breeder reactors. The major difficulty lies in achieving a high burnup of fuel. Burnups of 2 at. % were demonstrated with fuel surface temperatures about 600°C. Developments in refractory alloys and fuel element design are expected to increase these figures to 5 at. % at surface temperatures of 800°C, corresponding to a total fuel cycle cost of about 1 mill/kwh. A closed fuel cycle with pyrometallurgical processing will be required. Much depends upon the degree of success achieved with the EBR-II cycle, especially recovery rates, remote fabrication by injection casting, and the integrity of the fuel pins. To prevent bred plutonium from accumulating in the outer regions of the blanket for too long, a mobile blanket may be utilized, where the outer fuel elements gradually are transferred inward. In a mobile blanket the average amount of plutonium held up is only about $\frac{1}{3}$ of that in a fixed blanket. Another advantage is the steady heat generation rate at each radial position. A treatment of the physics and economics of some fuel cycles is given. (auth)

11264 FUSED PLUTONIUM AND URANIUM CHLORIDES AS NUCLEAR FUEL FOR FAST BREEDER REACTORS. M. Taube (Inst. of Nuclear Research, Warsaw). P.353-63 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

The selection of fused salts components containing U (as fertile material) and Pu (as fissionable material) as liquid fuel for fast two-region breeder reactor is discussed. The following criteria are used: nuclear criteria for fast neutrons: σ_c, $\sigma_{(n,p)}$, $\sigma_{(n,\alpha)}$ (cross sections), ξ (logarithmic decrement of energy), and chemical criteria (for t < 1000°K): ΔE (electronegativity), ΔG (free energy of formation), t_m (melting point), P (vapor pressure). The results may be compared with recent considerations. Only one anionic component conforms to all these criteria: chlorine (partially in form enriched Cl^{37}. The same criteria for cations, nuclear non-active salt diluent, gives as possible components the following metals: K, Na, Mg, Ca, and partially Cu and Zn. The suitable fused salts components are: UCl_3 (or UCl_4), $PuCl_3$ (or in some conditions $PuCl_4$) dissolved in binary fused eutectic containing a pair from following chlorides: KCl, NaCl, $MgCl_2$, $CaCl_2$, and also CuCl and $ZnCl_2$. The experimental investigation in this laboratory was limited to liquid-liquid extraction from fused salts phase: UCl_4–KCl–CuCl to organic phase: extractants: TOA, TBP, HDBP, diluted in diphenyl. The extraction process was realized at 180°C, in anhydrous conditions. The results showed the presence of UCl_5^- anion complex, and $Cu_2Cl_3^-$ anion complex as well as other species. (auth)

11265 THE FAST BREEDER REACTOR RAPSODIE. C. P. Zaleski and L. Vautrey (Commissariat à l'Énergie Atomique, Paris). p.365-8 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French, English, Russian, Spanish)

A fast-neutron, sodium-cooled reactor, RAPSODIE, taking its name from these two characteristics, is to be built at Cadarache in the South of France. The state of the project at the actual start of construction is described giving: the main neutron, thermal, and mechanical characteristics; a description of the reactor block, the fuel and fertile elements, thermal and biological shielding, coolant system, and neutron and thermal control mechanisms; a description of the coolant circuits, the primary sodium-cooled circuit and secondary NaK circuit; a description of the methods of handling assemblies and all active or contaminated components; a description of the leak-proof building, containing the reactor block and coolant circuits; reactor operating procedures; and a brief description of the group of buildings adjacent to the reactor hall, and of their functions. Because of its length and great number of illustrations the paper was not included in the report. Interested persons should write the authors at the following address: Centre d'études nucléaires de Cadarache, B.P. no 1, Saint-Paul-lez-Durance, Bouches-du-Rhône, et Centre d'études nucléaires de Fontenay-aux-Roses, B.P. no 5, Fontenay-aux-Roses, Seine. (auth)

11266 EXPERIMENTS PRIOR TO CONSTRUCTION OF THE RAPSODIE REACTOR. L. Vautrey and C. P. Zaleski (Commissariat à l'Énergie Atomique, Paris). p.369-74 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French, English, Russian, Spanish)

Before proceeding to the construction of the various reactor components of the Fast Breeder Reactor, RAPSODIE, many experimental studies of a hydraulic, thermal and mechanical character were carried out, or are under consideration, to test the validity of the principles adopted in the Preliminary Project. The following tests are discussed: studies of coolant circuit components, sodium pumps (mechanical or electromagnetic), Na–NaK and NaK-air heat exchangers, measuring instruments (flow-rates, temperatures), sodium purification circuits, etc; studies in cooling of fuel and fertile assemblies; studies of special reactor devices, fusible rotating linkage, parts of the control rod mechanisms; and study of the reactor block and coolant circuits as a whole. The mock-up, now nearing completion, reproduces on a scale of 1 : 1 the installation provided in the Preliminary Project and includes: the reactor block, to which is connected a high flow-rate sodium circuit, permitting of long-term tests and thermal shocks, a control rod testing circuit, and complete installation of the 1-MW and 10-MW coolant circuits, the performances of which it will be possible to check under various operational conditions. A safety study carried out on a 3 : 10 scale mock-up comprising the whole of the reactor block and shielding, with the object of limiting the effects of any accidental liberation of energy of an explosive character. Because of its length and great number of illustrations the paper was not included in the report. Interested persons should write the authors at the following address: Centre d'études nucléaires de Cadarache, B.P. no 1, Saint-Paul-lez-Durance, Bouches-du-Rhone, et Centre d'études nucléaires de Fontenay-aux-Roses, B.P. no 5, Fontenay-aux-Roses, Seine. (auth)

11267 OPERATING EXPERIENCE WITH THE BR-5 FAST REACTOR. M. S. Pinkhasik, N. N. Aristarkhov, and A. V. Karpov (Academy of Sciences, Moscow). p.375-402 of "Power Reactor Experiments. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

The BR-5 reactor is an experimental fast neutron reactor with a thermal output of 5 MW. The fuel employed is plutonium oxide, and the coolant is sodium, and the reflector consists of a thin layer of natural uranium surrounded by a thick layer of nickel. The physical characteristics of the reactor, as measured during start-up and operation are given. The neutron flux in the center of the core is 8.2×10^{14} n/cm^2 s. The results of investigation of the kinetics of the reactor, its temperature and power co-efficients, and the distribution of the number of fissions in different points in the core are reported. The results of measurement of the fluxes and spectra in the experimental channels of the reactor are also quoted. (auth)

11268 BORAX V INTEGRAL NUCLEAR SUPERHEAT REACTOR EXPERIMENTS. W. R. Wallin, R. E. Rice, and M. Novick (Argonne National Lab., Ill.). p.9-26 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

An integral nuclear boiling water and superheating steam reactor rated at 20 Mw(t) and designated, BORAX V, was designed and constructed by Argonne National Laboratory at the National Reactor Testing Station. It will generate steam by direct cycle boiling and will superheat it in special fuel elements located in the reactor core. Outlet steam will be at 600 psig and 850°F, and a 3500-kW turbine generator will be driven by it. The technical problems which are anticipated in the operation of a coupled boiling water-superheating reactor and the experimental program which was devised to attack them are described. (auth)

11269 SINGLE-PASS SUPERHEAT EXPERIMENTAL SET-UP AT THE FIRST ATOMIC POWER STATION REACTOR. V. V. Dolgov, V. Ya. Kozlov, L. A. Kochetkov, O. A. Sudintsyn, V. V. Sergeev, and G. N. Ushakov (Academy of Sciences, Moscow). p.27-40 of "Power

Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A single-pass experimental set-up with steam superheating in the reactor is described and the results of studies carried out on it are presented. Confirmation was obtained of the practical possibility of starting up a single-pass unit with nuclear superheating of steam by the method of gradually replacing water by steam in the super-heating channel; no switch over or change in the operation of the equipment of the installation is required. In emergency shutdowns, safe cooling of the fuel elements in the super-heating channel is fully assured, the temperature of the element wall sinks steadily. Prolonged operation of the steam super-heating channel in a steady state (more than 1000 h), and in transient conditions (more than 50 super-heatings) produced no defects; the great stability and reliability of the fuel elements of the First Atomic Power Station were confirmed, as was also the possibility of using them for operation under steam super-heating conditions. Steam was super-heated directly in the reactor to a temperature of 360°C at a pressure of 85 kg/cm^2. The maximum super-heating temperature reached in the experiment was 370°C. (auth)

11270 URANIUM–GRAPHITE POWER REACTOR WITH DIRECT STEAM CYCLE INTO TURBINE. N. A. Dollezhal, P. I. Aleshchenkov, I. Ya. Emel'yanov, et al. p.41-52 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In Russian)

Aspects of power reactor operations using a one-cycle scheme and the feasibility of increasing the power efficiency by developing steam pressure to 100 atm at 510°C are discussed. (R.V.J.)

11271 THE ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR. D. H. Imhoff (General Electric Co., San Jose, Calif.). p.53-79 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The Vallecitos Experimental Superheat Reactor (VESR) is a reactor experiment specifically designed to conduct development programs in the following areas: superheat fuel development; operating and safety characteristics of the world's first separate superheat reactor; system contamination from carryover of radioactive material; and integration of two reactor systems. Auxiliaries include steam condensing equipment and a gas fired steam boiler. Initial operation is scheduled for July, 1962 at 12 Mw(t) with provision for later doubling the power and employing steam from the Vallecitos Boiling Water Reactor (VBWR) and/or the gas fired boiler. The reactor vessel is 7 ft in diameter and 32 ft high. The reactor fuel is UO_2 with a 28-mil stainless steel clad arranged in a single annular geometry. The fuel bundles will be located in uninsulated process tubes and arranged in 32 separately manifolded bundles of 9 elements each. Superheat fuel experience was obtained in a superheat loop in the VBWR. It is expected that design information obtained from VESR operation will allow a large (300 to 450 Mwe) competitive separate superheat plant to be completed in 1967-68. (auth)

11272 APPLICATION OF SUPERCRITICAL STEAM PARAMETERS TO PRESSURIZED WATER POWER REACTORS. S. A. Skvortsov and S. M. Feinberg (Academy of Sciences, Moscow). p.81-95 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In Russian)

Change over to supercritical parameters provides a greater possibility of increasing the specific power of pressurized water reactors. In this case it is not possible to operate the reactor in a two-phase medium, and this removes the limitations associated with occurrence of surface and volume boiling and of critical thermal loads on the surface of the fuel elements. The adoption of supercritical parameters makes possible a substantial increase in the over-all efficiency of the installation (by 40 to 50% compared with the efficiency of current designs) and consequently the generation of electric power at a given thermal power can be substantially increased. The basic difficulties in building a power reactor with supercritical parameters are concerned with the construction of equipment (reactor vessel, circulating pumps, steam generators, etc.) required to work under stressed conditions. These difficulties are analyzed and the possibility of avoiding them are discussed. Variations in core arrangement are set out and criteria governing choice of thermal cycle for the power station are discussed. Finally, layouts for the control of reactivity with the minimum use of the mechanical rods of the shield control system are considered. (auth)

11273 CURRENT STATUS OF WORK IN SWEDEN ON A BOILING AND SUPERHEATING HEAVY-WATER REACTOR. P. H. Margen (Aktiebolaget Atomenergi, Stockholm). p.97-133 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

A design study is currently in progress concerning a D_2O-moderated and cooled direct cycle boiling reactor with natural circulation and integral superheating. The design is of the pressure vessel type and is rated at 400 Mw(e). While this type of reactor should combine the advantages of good neutron economy (heavy water), high thermal efficiency (about 37%), and reasonably low capital investment per kilowatt (no heat exchangers or main pumps, high specific heat ratings), there exist certain technical problems, for instance D_2O leakage in the turbine and condenser. The general aims of the design study and the supporting experimental program are to assess the technical problems for this type of reactor and its economic potential, particularly compared with the D_2O-moderated and cooled pressurized water reactor now being developed in Sweden. The basic design is described. Certain parts of the experimental program are discussed including work on: two-phase flow and burn-out, hydrodynamic stability calculation and correlation with experimental data, superheater design to increase surface performance, and leakage prevention in primary circuit, particularly the condenser. (auth)

11274 INVESTIGATIONS RELATING TO THE USE OF ZIRCONIUM ALLOYS IN STEAM-COOLED REACTORS. R. C. Asher, B. Cox, and J. K. Dawson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.135-47 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The steam-cooled and steam-generating heavy water moderated reactors studied by the UKAEA are based upon the use of zirconium alloy pressure tubes and fuel cladding. The useful life of these zirconium alloy components may be determined by a loss of ductility due to the precipitation of zirconium hydride arising from the corrosion reaction, rather than by penetration due to corrosion. It is important, therefore, to have knowledge of both the rate of corrosion and of the extent of hydrogen absorption under reactor conditions. A general investigation is proceeding at AERE, Harwell, on the nature of the corrosion of zir-

conium alloys in steam, and on the factors which affect the absorption of hydrogen during corrosion. The results are reported of out-of-pile investigations and of preliminary experiments in a high flux of fast neutrons. The application of these results to the prediction of the service life of zirconium alloy components in a reactor is discussed. (auth)

11275 PRELIMINARY CALCULATIONS FOR A FIXED BED FUEL ELEMENT. G. Perona and G. Palladino (Centro Informazioni Studi ed Esperienze, Milan). p.148-55 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The possibility of using fixed pebble-bed fuel elements for producing superheated steam is being examined. A fuel element consisting of small UO_2 spheres with cladding to protect the UO_2 from corrosion and to retain the fission products was developed. A diagram is presented showing the results of specific power calculations versus the diameter of the UO_2 spheres for maximum thermal and mechanical stresses. Heat transfer factor values were calculated for different pressure drops as a function of sphere diameter. (M.C.G.)

11276 THE MODIFIED SODIUM REACTOR EXPERIMENT. S. Siegel and R. W. Dickinson (Atomics International, Canoga Park, Calif.). p.159-82 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The sodium reactor experiment, originally built to demonstrate the feasibility of the sodium graphite reactor concept, has succeeded in this objective, and has produced valuable engineering information on fuel, sodium systems, and integration of a sodium-cooled reactor plant with a steam generating station. Advances in sodium reactor technology in the area of components, materials, and fuel indicated that a substantial increase in capability for power generation in sodium graphite reactors is warranted. Plans were therefore developed to enhance the power generating capacity of the sodium reactor experiment, utilizing the most recent technology available as a result of high temperature reactor development programs and operating experience, to increase the power level of the SRE to about 45 Mw(t) using substantially the same core and heat transfer system configuration. Specific power in the fuel elements, planned as uranium carbide, will be doubled from the present maximum of 340 kw/kg U^{235} to about 700 kw/kg. Heat flux from fuel element to coolant will be increased from the present average of 209 000 Btu/ft^2 h to a maximum of about 800 000 Btu/ft^2 h. Thermal neutron flux in the fuel will be increased from its present value of 2×10^{13} n/cm^2 s to 10^{14} n/cm^2 s, thus enhancing the value of the experiment as a high temperature fuel irradiation facility for complete fuel elements. Simultaneously, plans are being drawn to increase reactor outlet temperature to 1200°F, in order to provide steam at 1050°F as a demonstration of the capability of this type reactor to match the most modern fossil fired steam conditions. These improvements will be effected by use of uranium monocarbide as a fuel material, high strength zirconium alloy developed especially for sodium service as graphite cladding, installation of increased heat transfer surface in the radioactive-to-nonradioactive sodium heat exchanger, and increasing the heat dissipation capacity of the reactor system by combining an air blast heat exchanger with an existing turbo-generator installation. Upon completion of these planned modifications, the sodium reactor experiment will become essentially a new experiment to test advanced conditions, fuels, materials, and concepts in sodium-cooled reactor design. (auth)

11277 DESCRIPTION OF A SPECIFIC TEST REACTOR FOR STUDYING THE ORGEL SYSTEM. C. Chassignet, S. Finzi, J. Gretz, and J. C. Leny (Euratom, Brussels). p.183-212 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

The object of the ORGEL program is to develop the system of organic-liquid cooled, heavy-water moderated reactors. Euratom has drawn up a program of research for this purpose, and has started investigations on a reactor for specific tests within the ORGEL program. A description of this ESSOR (ORGEL experiment) reactor and of its use in developing the ORGEL system is presented. (auth)

11278 MEASURED PHYSICS PARAMETERS, DESIGN FEATURES AND OPERATING CHARACTERISTICS OF THE PRTR. J. R. Triplett and R. E. Peterson (General Electric Co., Richland, Wash.). p.213-27 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (HW-SA-2257) (In English)

The Plutonium Recycle Test Reactor at the Hanford Laboratories provides an experimental medium for resolving current uncertainties concerning the characteristics of plutonium-bearing fuels. The PRTR is a heavy water moderated and cooled reactor employing both plutonium and uranium as fuel. Several types of fuels will be studied in this facility, including variation in the plutonium isotopic ratio and PuO_2–UO_2 mixtures. The startup tests and initial operation of this reactor show that the temperature and void coefficients are negative, power distribution and fuel handling problems minimal, and kinetics and control characteristics very satisfactory. Analysis of these results indicate that these favorable characteristics are not always preserved in plutonium-fueled reactors of higher temperature, different type of moderator, or larger size. These studies will be extended to irradiated fuel elements, and to reactor lattices of several types, with the aid of the Plutonium Recycle Program Critical Facility, an adjacent zero-power test reactor. (auth)

11279 THE SAXTON EXPERIMENTAL POWER REACTOR. W. E. Shoupp, E. U. Powell, and J. Weisman (Westinghouse Electric Corp., Pittsburgh). p.229-51 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The 20-Mw(t) Saxton reactor now nearing completion is a pressurized water power reactor designed especially for experimental operation. A five-year program of engineering tests will be conducted aimed at better fuel utilization and lower nuclear power costs. The theme of the experimental program is the gradual pushing of Saxton reactor operating conditions beyond presently accepted design practices. The program will begin with a long term test of the suitability of dissolved neutron absorber for shim-type reactivity control. Following this a succession of small removable core subassemblies will be tested at progressively higher power levels to determine the limit of fuel capability. At high power levels and system pressure, the reactor will be operated with bulk boiling of the coolant, first in the hottest channels, then extending to conditions representing a high performance closed cycle boiling system. Boiling in conjunction with chemical shim control will be studied. Finally, the problems of nuclear superheat will be explored by a special test loop capable

of operation to 4000 psi and 1000°F. In order to facilitate experimental operation and the measurement of conditions within the reactor core, the plant design includes many special features. Bottom-mounted control rod drives permit the location of special access ports directly above the core. These will accommodate five removable test fuel assemblies, 23 thimbles for neutron flux measurement, and 14 positions for coolant temperature and flow measurement. Core conditions can thus be observed more accurately than in ordinary power reactors. Special features such as the oversized high pressure steam generator, oversized pressurizer, and variable speed pump give the plant exceptional flexibility in the selection of reactor operating conditions. The multi-layer reactor vessel used in Saxton will represent the first application of this type of construction in a commercial atomic power plant. (auth)

11280 THE VULCAIN REACTOR. P. E. Maldague (Belgo Nucléaire, Brussels). p.253-73 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Since the VULCAIN reactor has drawn particular attention from the OEEC experts in the ship propulsion field, it is interesting to examine its features. This reactor may be considered in some respects as an improved version of the pressurized water system, where a mixture of heavy and light water is used as primary fluid. The moderator and coolant circuits are separate, and the moderator temperature can be varied to compensate for short term reactivity changes such as Xenon and Doppler effects. Long term reactivity decreases due to burnup are compensated through injections, from time to time, of light water into the primary fluid. Large cylindrical holes in the core contain the variable temperature moderator, and are headed by hollow cylindrical shutoff rods with their drive mechanisms. These rods have a 50% Δk worth, due to the fact they act as neutron flux traps. Although reactivity lifetime has no more practical limitation, average burnups should be limited between 40 000 and 45 000 Mwd/t for economical reasons and because of fuel degradation. These high burnups are easily attained with batch loading (one refueling every three years) and uniform enrichment. Fuel inventory is very low, due to high average specific output (over 50 Mw(t) per ton uranium). Core dimensions are small; the average power density exceeds 90 kw/l. Reactor control is accomplished through a flow regulating valve on the steam line of the moderator circuit steam generator. All these features make this reactor economically attractive, specially in the power range to consider for ship propulsion or small power stations. The latest design of a 20 000 SHP unit might well compete within some years with the best diesels burning low cost fuel, notwithstanding the heavy extra-charges of a nuclear ship. (auth)

11281 KERNREAKTOREN FÜR SCHIFFSANTRIEBE. 2. JAHRBUCH DER STUDIENGESELLSCHAFT ZUR FÖRDERUNG DER KERNENERGIEVERWERTUNG IN SCHIFFBAU UND SCHIFFAHRT e.V. 1959. (Nuclear Reactors for Ship Propulsion. Second Yearbook of the University Association for Development of Nuclear Energy Uses in Shipbuilding and Shipping Registered Company 1959). E. Bagge and J. Scholvin, eds. Munich, Verlag Karl Thiemig KG, 1961. 185p. DM 21.

The 32 papers presented at the Second Annual University Association Meeting on Nuclear Reactors for Ship Propulsion are compiled. The topics discussed include general consideration and economics of nuclear propulsion, organic moderated marine reactors, pressurized water and boiling water reactors, gas-cooled marine reactors, effect of ship motion on reactor operation, problems of radiation protection, and special technical problems and insurance. Separate abstracts have been prepared for 28 papers; 4 were previously abstracted in NSA. (J.S.R.)

11282 CONSTRUCTION, OPERATION AND FUNCTIONS OF THE GEESTHACHT RESEARCH REACTOR. E. Bagge (Universität, Kiel). p.XXI-XXXI of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Forderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

A summary report is given of the construction, critical experiments, and start-up period of the Geesthacht Reactor. Emphasis is placed on the operational difficulties and their solution. The research being done or contemplated is briefly reviewed. (J.S.R.)

11283 COMPARISON OF NUCLEAR MERCHANT SHIP PROPULSION SYSTEMS. William A. Hepburn and David H. Specht (Maritime Administration, U. S. Dept. of Commerce, Washington, D. C.). p.1-9 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

The work being done with respect to applying different reactor concepts to merchant ship propulsion is discussed. The nuclear systems covered are the PWR, BWR, organic-moderated, and gas-cooled systems. These systems are evaluated in light of their potential and availability for merchant marine service by 1970. The information given in the comparisons includes the principal design data for the various cycles and reactors. The methods used for analyzing the systems and computing the capital, fuel, and operating costs were the same for all systems so that the results are comparable. (J.S.R.)

11284 DEVELOPMENT OF NUCLEAR SHIP PROPULSION IN GERMANY. K. Jllies. p.9-13 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The present state and the possible development of German studies on nuclear ship propulsion are summarized by a review of the work being done at the Kernenergiegesellschaft, Lehrstuhl für Schiffsmaschinenbau, and Fachausschuss Schiffssicherheit. (J.S.R.)

11285 A COMPARATIVE STUDY OF SOME REACTOR SYSTEMS FOR MARINE PROPULSION. R. P. Kinsey and H. W. Bowker (United Kingdom Atomic Energy Authority, [Eng.]). p.13-24 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

The engineering feasibility and economics of five selected reactor systems (gas-cooled, pressurized and boiling water, and organic moderator types) are compared for marine propulsion in the context of the 65,000 dwt tanker having a propulsion unit of 22,000 shp. In order to ensure realistic designs based on established nuclear technology and provide a fair basis for comparison, the A.E.A. selected for this study those systems which have been considerably developed for land-based operation but has not included all possible systems or variants. The study has established the feasibility of all the systems considered

for the marine application and has enabled the design and operational requirements for the marine environment to be better understood. Present estimates of operating cost, however, are significantly higher than for the conventional oil-fired vessel. It is concluded that no currently developed reactor system can yet be applied economically to marine propulsion. The study has highlighted the need to concentrate on reductions in capital cost and weight and engineering complexity, and to consider in more detail the influence of safety on the design concept. There is reasonable hope for significant reduction of fuel costs as nuclear technology develops and as improvements in core physics can be applied. (auth)

11286 ECONOMIC AND SOCIAL ASPECTS OF NUCLEAR ENERGY APPLICATION. G. Friedrichs (Industriegewerkschaft Metall, Frankfurt am Main). p.25-8 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The many and varied applications of reactor and radiation technology touch almost all phases of the economy. The direct consequences of these technologies on various industries are first considered. The significance of nuclear technology for expanding mechanization, concurrent automation, plastic technology, and office mechanization is illustrated, and the effects of industrial productivity on social and political problems are indicated. (J.S.R.)

11287 COMMERCIAL TANKER WITH REACTOR PROPULSION. J. P. Hulsman. p.29-30 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The history of the Dutch studies on the nuclear propulsion of a commercial tanker is briefly summarized. The study was directed toward the outfitting of a conventional tanker with a reactor which could then be used as sample, research, and laboratory ship. The objectives of the study group are then summarized. (J.S.R.)

11288 SOME PROBLEMS RELATED TO NUCLEAR PROPULSION DEVELOPMENT IN NORWAY. J. Wilhelmsen, Jr. (Institutt for Atomenergi, Kjeller, Norway). p.31-2 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

Navigation hazards, efficiency of conventional propulsion systems, and the demands of radiological safety place heavy burdens on the economy of a nuclear powered ship. The Norwegian approach to some of the problems connected with the development of nuclear propulsion is summarized. An indication of the nature of some investigations which are necessary for the solution of these problems is also given. The problem zones considered are system economy, operational stability, safety, and heat transfer. (J.S.R.)

11289 SKETCH OF A SHIP REACTOR COOLED AND MODERATED WITH ORGANIC SUBSTANCES. F. Faris (Interatom, Bensberg/Cologne). p.33-6 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The design of an organic cooled and moderated ship reactor, the OMR, is described. The organic coolant is a mixture of terphenyls. The reactor and its primary shielding, the coolant circuits and auxiliary systems, the control, nuclear instrumentation, and safety system, and the plant layout are discussed. (J.S.R.)

11290 CIRCUIT PLAN FOR SATURATED STEAM PROCESSES WITH ORGANIC-MODERATED REACTORS. H. Daldrup. p.37-40 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

In the design of the heat circuits and determination of the efficiency of a nuclear energy ship unit with saturated steam turbines, new problems occur in comparison with superheated steam installations. The principal formulas for the determination of the thermal total efficiency are given. A simplified diagram of the heat circuit is shown. Curves showing the effects of various parameters (such as steam pressure on shell side of heat exchanger, wave output, generator output, and heat exchanger dimensions) on the total thermal efficiency are given. (J.S.R.)

11291 POSSIBLE REDUCTIONS IN OPERATING COSTS DURING THE LIFE OF AN ORGANIC MODERATED REACTOR FOR SHIP PROPULSION. I. D. Neilson (Hawker Siddeley Nuclear Power Co., Langley, Bucks, Eng.). p.41-5 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

A reactor designed for commercial marine propulsion and which produces 20,000 shp(wps) is described briefly. The operating costs of an oil tanker fitted with this power plant are compared with the costs for a similar tanker fitted with a comparable oil-fired steam turbine. The effects of interest rates, other commercial considerations, and the possibilities of various technical modifications are considered. The paper is concluded by speculations on the combined effect of all these factors on the operating costs of the oil tanker. (J.S.R.)

11292 ORGANIC COOLANT MEDIUM IN THE OMR. W. Haubold (Interatom, Bensberg/Cologne). p.45-9 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The factors to be considered in the selection of an organic coolant for the OMR are reviewed. The pyrolytic and radiolytic stability of aromatic compounds is discussed and their behavior in the reactor is considered. Radiolytic mechanisms and the effects of additions on it are discussed. The method for the purification of the OMR coolant is briefly reviewed. (J.S.R.)

11293 CONTRIBUTION TO THE CORE DESIGN WITH TUBULAR FUEL ELEMENTS IN THE OMR. N. Papmehl and A. Mareske (Reaktorstation Geesthacht/Tesperhude, Ger.). p.50-1 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

Within the framework of the development work for an organic moderated ship reactor, various fuel elements and core designs were investigated with respect to their utility in this reactor type. The results of two sets of calculations, one for tubular fuel elements and the other for a plate core, on the reactor characteristics are shown by means of some examples. The thermal utilization, infinite multiplication factor, thermal flux pattern, Fermi age, critical radius,

and core radius were considered. In the calculations uranium alloyed with 3.5% Mo and 0.5% Si and clad with Al was the fuel. Enrichment factors of 1.5, 1.7, 2.0, 2.3, 2.5, and 3.5% were used. (J.S.R.)

11294 PROGRESS REPORT, 1959, N. S. SAVANNAH. Ralph W. Deuster (Babcock and Wilcox Co., New York). p.52-9 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

The nuclear design of the N. S. Savannah is reviewed. The propulsion system compartments, functional operation, principal reactor components, fuel elements, safety considerations, and test and operational plans are described. (J.S.R.)

11295 IMPRESSIONS ON PARTICIPATION IN THE CONSTRUCTION OF THE N. S. SAVANNAH. (SAFETY CONSIDERATIONS). G. Grossmann (Kieler Howaldswerke A. G., Kiel). p.60-1 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The discussion is limited to three points on the safety problems of the N. S. Savannah. The topics discussed are the collision safety, safety containment with the secondary shield, and the treatment of radioactive wastes. (tr-auth)

11296 A SMALL EXPERIMENTAL NUCLEAR SHIP. Muneo Yamaguchi (Mitsubishi Shipbuilding & Engineering Co., Ltd., Tokyo). p.67-76 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

The Nuclear Ship Specialist Committee has recommended to the Japanese AEC five types of nuclear powered ships, three tankers with size from 20,000 to 45,000 tons D/W, a passenger/cargo ship of 17,000 tons gross, and a small experimental ship of 4,000 tons gross, as suitable ships to be constructed in the near future for the development of nuclear ships in Japan. The tentative specifications for the small experimental ship are outlined, and the reasons for the selection of this ship are discussed. (J.S.R.)

11297 CONTRIBUTION TO THE STUDY OF A GAS REACTOR WITH SOLID MODERATOR FOR NAVAL PROPULSION. J. Phéline and A. Gautier. p.83-9 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In French)

The French studies on a gas reactor with graphite or beryllium oxide moderator to be used in naval propulsion are reviewed, with a brief discussion of the extent of the studies and the neutron investigations. A fuller description is given of the technological studies on the moderator, coolant, cladding materials, and fuel elements. (J.S.R.)

11298 THE MARITIME GAS-COOLED REACTOR PROGRAM. William I. Thompson (General Atomic Div., General Dynamics Corp., San Diego, Calif. and Electric Boat Div., General Dynamics Corp., Groton, Conn.). p.90-4 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

The system which couples the gas-cooled reactor to the closed-cycle gas-turbine power plant for use in marine propulsion is described. The reactor system, the special characteristics of the Maritime Gas-Cooled Reactor, and the program development are reviewed. The advantages of the system over oil-fired systems or other nuclear systems are discussed. (J.S.R.)

11299 GAS-COOLED REACTORS FOR SHIP STEAM TURBINE SYSTEMS. J. Busch (Technische Hochschule, Hanover). p.95-8 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The general components of a gas-cooled reactor for use with the steam turbine system of a ship are discussed. The advantages and disadvantages of various materials as coolants, moderators, fuel elements, and cladding materials are reviewed. For feasibility studies, the Calder Hall Reactor was used as a model, and a simplified diagram of the propulsion circuits is given. The operating characteristics are reviewed, with a more detailed discussion of the heat exchanger proposed. (J.S.R.)

11300 CONTRIBUTION BY W. R. WOOTTON (GREAT BRITAIN). p.99 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

The reasons for the British selection of the water-cooled reactor as the most promising for marine propulsion are reviewed and briefly discussed. (J.S.R.)

11301 SOME PROBLEMS OF TURBOENGINES FOR ATOMIC INSTALLATIONS. W. Spillmann (Escher Wyss A.G., Zurich). p.100-3 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The inertness and stability of helium combined with its very low thermal neutron cross section makes it of interest for use in gas-cooled reactors. The development of helium turbomachines, as closed-cycle gas turbines, was therefore emphasized. The characteristics of helium machines are first given. Then the problems connected with sealing and heat conduction are reviewed and amplified. The methods used for load control are indicated. (J.S.R.)

11302 THE CONVERSION OF NUCLEAR ENERGY INTO CURRENT AND HEAT. Karl Bammert (Technische Hochschule, Hanover). p.104-13 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

Heat is necessary in a ship not only for propulsion energy but also for space heating, cooking units, air-conditioning plants, etc. A summary study is made of a reactor and its cost structure when the reactor is to be used for both power and heat production. The installation is briefly described as an introduction to a cost calculation. The terminal power of the generator and the largest output are determined. The construction expenditure for individual components of the heat-power system is considered with a discussion of its economic feasibility. (J.S.R.)

11303 ON THE EXTERNAL FORCE ACTING ON THE MARINE REACTOR DUE TO THE SHIP MOTION IN ROUGH SEA. E. Kawashima (Kawasaki Dockyard, Kobe, Japan), M. Sakao, and R. Tasaki. p.114-22 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesell-

schaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

The external force acting on a ship reactor appears to be divisible into two components: the component from vibration or shock and the component from the ship motion. A quantitative study was made to determine the extent of this external force or acceleration created by the ship motion and vibration. The results of the measurements are shown graphically. (J.S.R.)

11304 THE SAFETY CONTAINER OF POWER REACTORS. Th. Jaeger. p.122-5 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The potential energy sources which could effect the release and dispersion of radioactive materials are considered as an introduction to the study of the containment vessel of power reactors. The possible forces which the containment vessel must contain are discussed, and the factors affecting the design of the vessel are reviewed. Two feasible solutions in the design are described. (J.S.R.)

11305 SECONDARY SHIELD DESIGN OF A PWR FOR SHIP PROPULSION. A. M. Moncassoli (FIAT. Sezione Energia Nucleare, Turin). p.126 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In English)

The shielding requirements of the 74 Mwt PWR nuclear propelled tanker are evaluated with emphasis placed on the optimization of the secondary shield. The reactor core, primary loop characteristics, and source evaluation are described. Then the cylindrical source attenuation and the gamma isodose are calculated. Neutron isodose calculations are also made. (J.S.R.)

11306 INVESTIGATION ON THE RADIATION PROTECTION OF CONSTRUCTION MATERIALS. E.-G. Niemann (Technische Hochschule, Hanover). p.130-2 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

Some investigations on various types of concretes, which were used for radiation protection, are reported. Since the present studies were only model investigations, which concerns only the principle of the measurement method, the investigations were made with the γ radiation from radioisotopes, especially Cs^{137}. The effect of geometry, the change of the energy spectrum, and some neutron activation studies are reported. (J.S.R.)

11307 CALCULATION OF LAMINATED SHIELDS BY THE REMOVAL CROSS SECTION METHOD. S. Sasse (Technische Hochschule, Hanover). p.133-5 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

By means of examples, it is shown how one can make fast, complete, and clear shield calculations for laminated shields with the removal cross section method. Homogeneous shields are first considered, and then calculations for heterogeneous shields are indicated. (J.S.R.)

11308 INSTRUMENTATION PROBLEMS IN NUCLEAR REACTORS FOR SHIP PROPULSION. M. G. Vallauri (FIAT. Sezione Energia Nucleare, Turin). p.138-41 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

As a prerequisite for a detailed consideration of the problems connected with the nuclear instrumentation in ship reactors, an inventory is given of the measurements connected with reactor operation. The utilization of semiconductors in the design of nuclear instruments is briefly indicated. (J.S.R.)

11309 INSURANCE QUESTIONS FOR NUCLEAR FUELS IN SHIP REACTORS. H. Hardung-Hardung. p.142-4 of "Kernreaktoren für Schiffsantriebe. 2. Jahrbuch der Studiengesellschaft zur Förderung der Kernenergieverwertung in Schiffbau und Schiffahrt e.V. 1959." Munich, Verlag Karl Thiemig KG, 1961. (In German)

The factors affecting the insuring of nuclear fuels in ship reactors are reviewed with emphasis on those factors which are peculiar to ocean vessels. (J.S.R.)

11310 COMBINATION OF A NUCLEAR POWER PLANT WITH A SEPARATELY FIRED SUPERHEATER. Fritz Marguerre. British Patent 889,424. Feb. 14, 1962.

A nuclear power station and a method for operation thereof are described for supplying a variable electrical load. During periods of low load, only the reactor is operated, whereas in periods of high load, both the reactor and the superheater are operated, and at peak load the heat accumulator is discharged also. (D.L.C.)

Production Reactors

11311 (HW-69632) NPR PROJECT SECTION MONTHLY DESIGN TEST AND DEVELOPMENT PROGRAM STATUS REPORT—CAI-816, APRIL 1961. L. P. Reinig (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 30, 1961. Contract AT(45-1)-1350. 30p.

The status of the design and development programs are summarized numerically. The total over-all % complete is reported at 83.4. A tabulation of completeness on all tests is also included along with a report of progress on programs which will be used for NPR startup, operation, and future design. (J.R.D.)

11312 (HW-72217) FUEL CYCLE ANALYSIS FOR SUCCESSIVE PLUTONIUM RECYCLE. I. RESULTS FOR FIVE REACTOR CONCEPTS. E. A. Eschbach, D. E. Deonigi, M. F. Kanninen, D. P. Granquist, G. J. Busselman, and B. B. Lane (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1962. Contract AT(45-1)-1350. 163p.

The MELEAGER CHAIN code of the Hanford Laboratories was used to compute plutonium values in five simulated power reactors (APWR, BWR, OMR, D_2O, and GAS-COOLED). For all parameters considered, the values ranged from about $10 to $13 per gram of fissile material for the first recycle step, based on the current uranium price schedule. The variations included batch and graded fuel cycles, AEC and private ownership of fuel, premium costs for plutonium fuel processing, zoned and unzoned reactors, and basic physics constants. As used here plutonium value is defined as the price of plutonium that yields the same fuel cost whether a given reactor is fueled with plutonium or with uranium. The constraints of the computer models are such that high plutonium values do not necessarily imply low power costs nor do low plutonium values imply high power costs. Furthermore, it is important that

the term "value" should not be confused with the term "price", a marketing term, beyond the scope of this study. Discussion is included which indicates that plutonium values may be greater in reactors optimized for $U^{235}-U^{239}$ fueling if the spatial concentration of U^{238} is reduced when plutonium fueling is used; this permits better utilization of the fertility of Pu^{240}. Furthermore, with no U^{238}, or with only a little, some compositions of plutonium (Phoenix Fuels) exhibited essentially constant reactivity for extraordinarily long lifetimes. (auth)

Research Reactors

11313 (ANL-6451) STATUS REPORT ON THE ARGONNE ADVANCED RESEARCH REACTOR. D. H. Lennox, E. W. Barts, R. V. Batch, F. C. Beyer, G. L. Jorgensen, C. N. Kelber, H. F. Reed, G. T. Rezek, G. S. Rosenberg, H. C. Stevens, and R. J. Weatherhead (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-eng-38. 166p.

The interim design and development status is reported. The scope of the work was limited to conceptual design studies supported by critical experiments plus heat transfer and hydraulic tests. Design criteria, facility and site, reactor, core geometry and composition, fuel elements, reflector, core and reflector support structure, reactor vessel, control and instruments, primary coolant systems, secondary coolant system, auxiliary systems, experimental facilities, building layout and construction, plant ventilation, heating and air conditioning, critical experiments, reactor physics, heat transfer studies, and shieldings are discussed. (M.C.G.)

11314 (APEX-716) ENGINEERING CAPABILITIES OF IN-PILE IRRADIATION FACILITIES USED BY GE-ANPD. R. J. Harry and R. C. Fries (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Oct. 1961. Contract AF33(600)-38062 and AT(11-1)-171. 80p.

GE-ANPD had exclusive use of irradiation testing facilities in four reactors: the Materials Test Reactor (MTR), the Engineering Test Reactor (ETR), the Low Intensity Test Reactor (LITR), and the Oak Ridge Research Reactor (ORR). A compilation of data concerning the GE-ANPD facilities in these reactors is presented. Instrumentation capabilities, dimensions of the in-pile tubes, flow characteristics, control capabilities, and detailed design data are listed. (auth)

11315 (CNEN-101) CALCOLI PRELIMINARI PER UN REATTORE PER PROVA MATERIALI. (Preliminary Calculations for a Material Test Reactor). U. Farinelli, A. Gandini, and C. Tamagnini (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Oct. 1961. 38p.

Various possibilities were considered for the nuclear design of a material test reactor; the parameters were optimized for each type. Interference of various experiments and homogeneity of fluxes are discussed. (auth)

11316 (CRRP-1045) MULTIGROUP DIFFUSION CALCULATIONS OF THERMAL NEUTRON SPECTRA IN CANDU USING A FREE GAS MODEL. J. M. Kennedy and R. M. Pearce (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1961. 66p. (AECL-1414)

The datatron programs FREE GAS and MULTIGROUP were used to calculate the thermal neutron spectrum as a function of radius in a CANDU cell and to investigate the neutron heating effects of the coolant. The calculated distribution of thermal spectra through the lattice cell is in reasonable agreement with experiment. A bump on the spectrum-joining function is largest at the cell boundary and smallest inside the fuel rod. The small size of the in-fuel bump is caused by 1/v absorption and also the Maxwellian being subtracted is more energetic than the Maxwellian at moderator temperature which is more physically connected with the bump. (J.R.D.)

11317 (JÜL-23-RX) THE REACTOR FRM OF THE TECHNISCHE HOCHSCHULE MUNCHEN, ORGANIZATION. L. Koester (Munich. Technische Hochschule). Oct. 1961. 10p.

The reactor-group for FRM, a 1-Mw swimming-pool reactor, includes three sections for (1) operations, (2) health physics, and (3) irradiations and measurements. The present staff is described and requirements for future full-time operations given. Operational procedures are described which include advice given to experimenters in the setup of equipment near the reactor and safety controls in reactor operation and experiments. (D.L.C.)

11318 (JÜL-24-RX) FACILITIES OF A 1 MW SWIMMING POOL REACTOR FOR LOW COST OPERATION AND RESEARCH. M. Pollermann (Munich. Technische Hochschule). Oct. 1961. 19p.

This report is Part B of: H. Maier-Leibnitz and M. Pollermann: THE REACTOR FRM OF THE TECHNISCHE HOCHSCHULE MÜNCHEN: PROGRAM AND FACILITIES.

Remarks are made on the design of small swimming pool reactors for research. Facilities and components are described for reactor operation, health physics, waste disposal, low- and high-dose irradiation, laboratories for handling irradiated samples, and beam tube and loop experiments. (D.L.C.)

11319 (JÜL-25-RX) RESEARCH PROGRAM AND FACILITIES OF THE FRM. H. Maier-Leibnitz (Munich. Technische Hochschule). Oct. 1961. 11p.

This report is Part A of: H. Maier-Leibnitz and M. Pollermann: THE REACTOR FRM OF THE TECHNISCHE HOCHSCHULE MÜNCHEN: PROGRAM AND FACILITIES.

The principles are given upon which the erection and operation of the FRM reactor, a 1-Mw swimming pool reactor, were based. The facilities are described, and a short summary of the research program and the usefulness of the reactor is given. (D.L.C.)

11320 UTILIZATION OF THE VVR-S REACTOR FOR THE OSCILLATING PILE METHOD. A. Stefănescu and M. Sabău (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 543-56(1961). (In Rumanian)

The experimental results and the performances obtained by this method for the measurement of the capture cross section in the VVR-S Reactor are described. The sensitivity of the reactor in the case of the oscillating pile method with total variation and the optimum conditions for utilization of reactors of this type were determined. (tr-auth)

11321 DISTRIBUTION OF THE NEUTRON FLUX AND THE γ RADIATIONS IN THE VVR-S REACTOR. Th. Roşescu and M. Sabău (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz., Studii cercetări fiz., 12: 563-9(1961). (In Rumanian)

The values of the flux of thermal, epithermal, and fast neutrons and of γ radiation at various sites of the VVR-S Reactor are given. These fluxes were determined by activation measurements, chemical dosimetry, and measurements with counters and ionization chambers. They were also calculated. (tr-auth)

11322 THE ACTIVATION OF THE COOLANT WATER CIRCULATING IN THE PRIMARY CIRCUIT OF THE VVR-S REACTOR AT BUCHAREST. A. Filip, I. Grancea, and

E. Ionescu (Inst. of Atomic Physics, Bucharest). Acad. rep. populare Romîne, Inst. fiz., atomică şi Inst. fiz. Studii cercetări fiz., 12: 589-93(1961). (In Rumanian)

The results of measurements of the radioactivity of the water circulating in the primary coolant circuit of the VVR-S Reactor are given. The aim was the determination of the radioactive elements appearing in this circuit but not caused by the neutron activation of the H and O atoms, in order to study the corrosion processes in the circuit. (tr-auth)

11323 DETERMINATION OF THE FAST FLUX IN THE NUCLEAR REACTOR JEN-1. E. Artacho Savirón and J. Montes Ponce de Leon (Junta de Energia Nuclear, [Madrid]). Anales real soc. espăn. fís. y quím. (Madrid), Ser. A, 57: 135-42(May-June 1961). (In Spanish)

The fast flux in the center of the reactor JEN-1 core is shown to be different from the fission spectrum. Threshold detectors have been used and the experimental results have been adjusted using simple assumptions. (auth)

11324 DETERMINATION OF THE CADMIUM RATIO IN THE WATER REFLECTOR OF THE JEN-1 REACTOR. L. Mañas Díaz and J. Montes Ponce de Leon (Operations Group JEN-1 Reactor, Madrid). Anales real soc. espăn. fís. y quím. (Madrid), Ser. A, 57: 209-16(July-Aug. 1961). (In Spanish)

The cadmium ratio of manganese has been measured in the water reflector of the JEN-1 reactor. Values of the cadmium ratio are plotted and adjusted by a function obtained using three groups calculations, in which one group is given by the removal cross section theory. (auth)

11325 DETERMINATION OF CURVE FOR RELATING REACTIVITY FRONTS OF PERIODS IN AN ARGONAUT REACTOR. C. Fernández Palomero and L. Alverez de Buergo (Junta de Energia Nuclear, Madrid). Anales real soc. espăn. fís. y quím. (Madrid), Ser. A, 57: 217-22(July-Aug. 1961). (In Spanish)

Numerical and graphical determinations were made of the $\rho = \phi(t)$ relation for one slab loading in an Argonaut-type reactor. The inhour equation was used, but an oppor-tune correction was made on the β value because of the small size of the reactor type. The Keeping, Wimett, and Ziegler values for β_i and λ_i were used for the different groups of delayed neutrons. (auth)

11326 THE EDUCATION REACTOR "ULYSSE." Bull. inform. sci. et tech. (Paris), No. 57, 51-61(Dec. 1961). (In French)

Ulysse is an Argonaut type reactor of 100 kw, equipped with a large number of experimental facilities. The considerations governing the choice of this type of reactor are briefly listed; the reactor and its experimental units are described; and the role of Ulysse in educational courses is shown and the program for its use outlined. (auth)

11327 THE BATTELLE RESEARCH REACTOR. J. N. Anno and A. M. Plummer (Battelle Memorial Inst., Columbus, Ohio). Research Reactor J., 2: No. 2, 1-13 (Jan. 1962).

The characteristics, experimental facilities, operating experience, and operating costs of the Battelle Research Reactor, pool-type, are described. The 2-Mw reactor is equipped with the following facilities: shielding facility, neutron diffractometer, fission gas release facility, neutron activation facility, in-pile loop, modified pile oscillator, high vacuum facility, and cryogenic facility. A description is given of each. The cryogenic facility is in the design stage. (N.W.R.)

11328 " DEMOCRITUS" GREEK RESEARCH REACTOR-1. Nicholas Chrysochoides, Constantine Mitsonias, and Neophytos Papadopoulos (Greek Atomic Energy Commission). Research Reactor J., 2: No. 2, 14-17(Jan. 1962).

The Greek Research Reactor (GRR-1) located at the Nuclear Research Center (Democritus) near Athens is described. The reactor is a 1-Mw pool type, light water moderated and cooled, heterogenous reactor. The general specifications and reactor program are outlined. A brief description is also given of the experimental facilities, control system, cooling system, and purification system. (N.W.R.)

SPACE APPLICATIONS AND TECHNOLOGY

Refer also to abstracts 9761, 10400, and 10423

11329 (DC-59-12-183) DISCUSSION OF PERFORMANCE CALCULATIONS OF NUCLEAR ROCKET ENGINES. Eleanor L. Semple (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 21, 1959. Contract AT(11-1)-171. 14p.

Some of the fundamental relationships in a nuclear rocket engine are discussed. The equations required to calculate the performance of the rocket are presented. The problems associated with these calculations are also pointed out. (auth)

11330 (ERR-SD-135) PRELIMINARY ANALYTICAL STUDY OF A NUCLEAR TURBO-GENERATOR SPACE POWER CYCLE UTILIZING A CHEMICALLY-REACTING GAS AS A WORKING FLUID. R. E. Forrette (General Dynamics/Convair, San Diego, Calif.). Aug. 4, 1961. 30p.

A preliminary analytical study of a nuclear turbo-generator space power system is carried out. The system utilizes the heat of reaction of a chemically-reacting gas as a method of energy exchange. The reacting-gas cycle is compared to the basic Brayton gas cycle and the Rankine vapor cycle on the basis of radiator area per unit power output. The comparison indicates that the performance of the reacting-gas cycle is markedly superior to that of the Brayton cycle, and may potentially equal or surpass the Rankine vapor cycle performance, provided appropriate gas reactions may be developed and optimized for the given cycle requirements. (auth)

11331 (JPL-TR-32-160) INSTRUMENTATION REQUIREMENTS FOR THE ENGINEERING EVALUATION OF NUCLEAR-ELECTRIC SPACECRAFT. Warren C. Apel (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Oct. 25, 1961. 14p. Contract NASw-6.

Spacecraft employing nuclear-electric propulsion are being proposed for missions to Venus and distances beyond. These spacecraft utilize a nuclear reactor to provide thermal energy to a turboalternator which generates electric power for an ion motor and the other spacecraft systems. The instrumentation and communications systems needed to evaluate nuclear-electric spacecraft in flight are discussed, along with associated problems. A representative spacecraft design is presented, and a basic communications system is considered for transmitting data to Earth. The instrumentation and communications system, as well as all electronic systems on nuclear-electric spacecraft, will be operating in high temperature and nuclear-radiation environments. The problems caused by these environments are discussed, and possible solutions are offered. (auth)

11332 (LA-2656) SINGLE STAGE ORBITING VEHICLES. Ralph S. Cooper (Los Alamos Scientific Lab., N. Mex.). Jan. 2, 1962. Contract W-7405-Eng-36. 29p.

The performance capabilities of single stage rockets using chemical O_2-H_2 and/or nuclear H_2 propulsion were examined and found to be adequate for the Earth surface to low orbit mission. Depending upon the assumptions for the structural parameters, chemical vehicles can orbit payloads of 4 to 6% of the launch weight whereas nuclear stages can orbit 15 to 21%. The nuclear stage has approximately the same volume as the chemical stage and somewhat smaller manufactured mass. The chemical stage performance is more sensitive to the propulsion system and mission parameters. A hybrid chemical-nuclear single stage vehicle was examined and found to have several advantages over either pure system at the cost of added complexity. Possibilities for advanced nuclear engines utilizing dust bed or liquid core reactors indicated much improvement for H_2 propulsion and interesting possibilities for other propellants, particularly NH_3. (auth)

11333 (NASA-TN-D-1123) ROCKET MEASUREMENTS OF THE UPPER IONOSPHERE BY A RADIO PROPAGATION TECHNIQUE. S. J. Bauer and J. E. Jackson (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Feb. 1962. 12p.

Presented at International Convention on Radio Techniques and Space Research, Oxford, England, July 5-9, 1961.

High-altitude measurements of the electron density distribution were performed well above the F2 peak of the ionosphere by using the two-frequency rocket-borne propagation experiment of Seddon. An example of a measurement of the electron density profile up to 620 km by means of the CW propagation technique is presented, including the inferred scale height and temperature of the upper ionosphere. For the anticipated measurements up to one earth radius by the CW propagation experiment, the variation of the ionosphere below a vehicle must always be considered in order to arrive at reliable local electron density data. A correction for this time variation can be made by using recorded information on the ordinary and extraordinary propagation modes at two harmonically related frequencies. This correction procedure is briefly outlined. (auth)

11334 (NASA-TN-D-1166) A COMPARISON OF REVERSE-FEED AND POROUS-TUNGSTEN ION ENGINES. Thaine W. Reynolds and J. Howard Childs (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Feb. 1962. 33p.

Comparison of the theoretical performance of reverse-feed and porous-tungsten cesium ion engines at low power efficiencies shows the porous-tungsten engine, with 1- to 2-micron pore size, to have better propellant utilization efficiency and lower charge exchange currents than the reverse-feed engine. At higher power efficiencies, both the charge exchange currents and the propellant utilization efficiencies became comparable for the two engines. (auth)

11335 (NP-11344) SPACE PROGRAMS SUMMARY NO. 37-12, VOLUME I, SEPTEMBER 1, 1961–NOVEMBER 1, 1961. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Dec. 1, 1961. Contract NASw-6. 94p.

The major Ranger effort was involved with two unsuccessful efforts to launch Ranger RA-2 at AMR. Just prior to the third launch attempt, all effort to make the October 20 to 26 firing period was cancelled as a precautionary measure, based upon information concerning the inflight failure of an Agena the preceding night. The Ranger RA-3 and -4 operations are still progressing on schedule. A slippage in the schedule of the Atlas-Centaur vehicle, announced during September 1961, resulted in the cancellation of the Mariner A project and a reprogramming of the Mariner B project. To provide a mission to Venus in 1962, the Mariner R project was initiated, with a reduced weight spacecraft based on Mariner A and Ranger technology for use with the Atlas-Agena B vehicle. This new Mariner B design, to be used with the Centaur vehicle, is intended to be launched at all Mars and Venus opportunities in the period 1964 to 1967.

System tests are presently being made on the newly installed Cassegrain feed system at Goldstone. To improve the performance of the phase-lock receiving system at Goldstone, a redesign of the unit is underway. A site has been selected at Goldstone for the large antenna of the Advanced Antenna System and supporting studies on feed and structural designs are being made. (auth)

11336 (NP-11385) SPACE PROGRAMS SUMMARY NO. 37-13, VOLUME I, NOVEMBER 1, 1961–JANUARY 1, 1962. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Feb. 1, 1962. Contract NAS-7-100. 94p.

The launching and brief flight of Ranger II are described. It is noted that Ranger II failed because of an inoperative roll gyro, however, the spacecraft survived launch and performed its functions in orbit. In the planetary-interplanetary program procurement and fabrication of Mariner R assemblies are almost complete. Preliminary design of Mariner B is in progress. Details of design concerning these vehicles are included along with program objectives and missions. A report of activities at the deep space instrumentation facilities is also given. Included are details of Ranger II tracking, research and development of transponder ranging system, receiving systems, radar systems, and low noise systems. Development of Goldstone communications stations is also discussed. Design efforts concerning a new large aperture, low noise, antenna system for receiving data from spacecraft at an increased rate are summarized. (J.R.D.)

11337 (NP-11404) ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY VOL. V, NO. 1. ENTRIES 50,001–50,205. E. M. Carringer, M. G. Hoppe, and B. H. Nichols, comps. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Jan. 1962. Contract NAS7-100. 42p.

A bibliography of 204 references is presented on spaceflight and applicable data and techniques. (D.L.C.)

11338 (R61SD150) VELOCITY PROFILES AND EFFICIENCY OF MHD GENERATORS WITH SEGMENTED ELECTRODES. H. Yeh, and G. W. Sutton (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Sept. 15, 1961. Contract AF 49(638)-914. 39p. (AFOSR-1595; AD-266275)

The two-dimensional problem of an infinitely long magnetohydrodynamic generator with segmented electrodes of finite length was solved for constant properties, including the Hall effect. First, it was shown that the non-uniform current distribution does not affect the velocity profile, which is therefore parabolic for laminar flow. Second, the generator efficiency (not including friction) is exactly equal to the generator loading factor even for a non-uniform velocity. In these investigations it was assumed that opposite pairs of electrodes have no mutual influence. This assumption was verified when the Hall effect is absent even when the electrode pitch is equal to channel width. (auth)

11339 (UCRL-5916) ANALYSIS OF THE MOON'S SURFACE BY NUCLEAR REACTIONS. E. F. Martina (Space Technology Labs., Los Angeles) and Carlton D. Schrader (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 1, 1960. Contract [W-7405-Eng-48]. 33p. (STL/TR-60-0000-00078)

Information is summarized that will be useful in examining the feasibility of an early nuclear experiment to determine the elemental constituents of the lunar surface. It is postulated that it may be possible to perform an analysis without complex and elaborate manipulations, sample preparation, or rigid geometrical constraints. Only those experimental designs are discussed that come within the presently-available, or very near future, general boundary conditions on weights, power, and vehicles. The bombardment of the lunar surface with various nuclear beams and the examination of possible nuclear reactions which are known to be dependent on the mass and charge of the irradiated material are considered. Bombardment by neutrons or protons is discussed and a list is included of available accelerators and their respective neutron and proton outputs. Two separate experimental designs are considered, one based on γ production by neutrons and the other on γ production by protons. An electronic block diagram is presented for the neutron-gamma experiment. It is concluded that an analysis of the lunar surface by means of nuclear reactions may be quite feasible. Large numbers of nuclear reactions could be produced and detected and that information could be stored, transmitted, and received. The nuclear part of the experiment including accelerator, detector, pulse height analyzer, transmitter, and power source could be contained in about a 25 kg package. Data are appended on the compatibility of these experiments with other components of the total vehicle. (C.H.)

11340 (UCRL-5967-T) NUCLEAR EMULSION EXPERIMENTS IN THE INNER RADIATION BELT. Stanley C. Freden, Albert J. Oliver, and R. Stephen White (California. Univ., Livermore. Lawrence Radiation Lab.). [nd]. Contract [W-7405-Eng-48]. 6p.

Plans to measure electron and proton fluxes in the inner and outer earth-surrounding radiation belts are described. Two nuclear emulsion experiments were carried out in the inner belt during 1959 and several more are planned. Procedures and results of these tests are discussed. (J.R.D.)

11341 (WADD-TR-60-872) DESIGN STUDY FOR ADVANCED SOLAR THERMIONIC POWER SYSTEMS. ITEM III. ELECTRICAL CHARACTERISTICS STUDY. Interim Summary Technical Report No. 2. Engineering Report No. 4262. (Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland and Thermo Electron Engineering Corp., Cambridge, Mass.). Dec. 1, 1960. Contract AF33(616)-7411. 93p. (AD-260068)

Results of a theoretical and experimental study of electrical characteristics of cesium-vapor and vacuum thermionic generators are presented. This study was conducted to support and supplement designs for 250-watt generators using cesium and vacuum converters presented in WADD TR 60-698. Also, information on response of thermionic generators to sudden changes in load was sought to support recommendations for conversion and regulation of the converters' output. Such recommendations are given. The results of this study indicate that a non-optimized cesium converter, operating at emitter temperatures below that assumed in the WADD TR 60-698 can give the performance predicted in that report. Indications are that further testing will disclose conditions for substantially improved performance. A wire spacer technique for vacuum diodes was investigated and proven entirely successful. This technique offers substantial advantages over sapphire spacers and simplifies considerably the design for the 250-watt vacuum generator. The response of both cesium and vacuum generators to sudden changes in load appears to be instantaneous for all practical purposes, thereby permitting the use of switching type voltage regulators which offer particular advantages in space applications. (auth)

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 9835

11342 (EURAEC-83) WASTE DISPOSAL. Quarterly Report No. 2, 3rd Quarter, 1960. (Brussels. Centre d'Etude de l'Energie Nucleaire). 1960. Work performed under United States-Euratom Joint Research and Development Program. Contract [010-60-4-RDB]. 50p.

Progress is reported on the design and construction of an incinerator for radioactive wastes. Methods for the purification of smoke were investigated and the merits of various filtering systems are discussed. The technique of mixing tar with radioactive sludges to make them less s soluble was evaluated. The use of active carbon as an iodine filter and the performance of a recycling system consisting of a tube reactor filled with active carbon are discussed. Results are included from a comparative study of the characteristics of I^{131} as a ground water tracer with and without the addition of KI carrier. Techniques for measuring ground water flow are discussed. The migration of Sr^{89}, Cs^{137}, and Eu^{152} in soil and the effect of pH on retention capacity in water was investigated. (C.H.)

11343 (ORNL-TM-127) LABORATORY PROGRESS ON THE DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE BY DEEP-WELL INJECTION. W. J. Lacy, O. M. Sealand, D. G. Jacobs, and E. G. Struxness (Oak Ridge National Lab., Tenn.). Mar. 7, 1962. Contract W-7405-eng-26. 45p.

Results of laboratory studies on the neutralization of Purex-type wastes are reported, including the radiochemical distribution of the fission products in the precipitate and supernate and the effect of sodium and calcium neutralizations on fission-product separation. The problem of interstitial precipitation encountered when a second incompatible liquid is injected into a formation is discussed. Results indicate a piston-like displacement of the interstitial liquid by the injected waste with only a small zone of precipitation formed along the contacting edge. Slurry tests were performed to determine the capacity of various geologic materials for sorption of cesium and strontium from a synthetic Purex-type waste containing carriers and tracers. The materials studied include sands, feldspars, shales, clays, and limestone. The amount of cesium sorbed was found to be a function of several variables, among which are concentration of cesium in the waste, concentration of other cations, amount and nature of the clay material, and composition and amounts of other minerals in the disposal formation. Several types of shales and clay minerals, including illite, bentonite, montmorillonite, kaolinite, halloysite, and Conasauga shale, were slurried with simulated neutralized 6 M Purex waste. Sorption of cesium ranged from 0.6 to 6.0 mg/20 g, respectively, for the various materials tested. Results of slurry tests indicated that if the Purex-type waste were diluted 30 to 1 with concentrated brine, the amount of cesium sorbed per cubic foot would be about 2.7 curies. This is within the 2 to 8 curries/ft^3 estimated to be safe from thermal considerations. Core tests on a Berea sandstone showed similar sorptive capacities. Sequestering or complexing agents, that is, versenes, did not materially affect the cesium removal, but did result in a decreased sorption of strontium by clays. Strontium sorption in systems studied ranged from less than 0.2 to 2.0 mg of strontium sorbed per 20 g of clay. Slurry results indicated increased H ion concentration decreases sorption; sorption of cesium is a function of the Na/Ca ratio; the Na/Sr ratio is not as important to strontium removal as pH of the solution; and limestone slightly decreases the amount of cesium sorbed per gram of illite. The results of the sorption studies suggest that undue localized heat production, due to sorption of radioactive materials near the well, can be controlled so that it will not be a serious problem. (auth)

11344 (TID-13942) STRENGTH TESTS OF PROTOTYPE SEA DISPOSAL CONTAINERS FOR RADIOACTIVE WASTES. Final Report. Jack R. Pohlman and M. M. Lemcoe (Southwest Research Inst., San Antonio). Oct. 20, 1961. Contract AT(30-1)-2647. 63p.

The containability of several designs of containers used for the disposal of radioactive wastes in the deep sea was investigated. The different container configurations investigated were similar, in that the basic items used in their construction were standard 55 gallon drums and concrete. The differences in the container types were obtained by varying the following parameters: thickness of concrete shell, inclusion or no inclusion of steel reinforcing fabric, void space (stiffness) within the waste materials packed inside the container, and size and shape of vents used for pressure equalization. The testing was conducted in two phases. Phase I consisted of testing containers, wherein, pressure and impact were applied separately. Phase II consisted of testing containers, under the simultaneous application of pressure and impact, with measurement of their velocity just prior to impact. It was found that a satisfactory container for radioactive waste disposal in the deep sea could be fabricated from the basic materials used, provided that proper fabrication technique and procedure were utilized. (auth)

11345 (TID-14867) RESULTS OF AN INVESTIGATION ON THE REMOVAL OF A RADIOACTIVE ISOTOPE (I^{131}) FROM SEWAGE BY THE USE OF LABORATORY TRICKLING FILTERS. Melvin Whitehead Carter (Oak Ridge National Lab., Tenn.). June 1951. 100p.

Thesis submitted to Georgia Inst. of Tech.

A literature survey was conducted to gain background information on trickling filter theory and operation and on employing biological treatment to problems in radioactive waste disposal. Four laboratory trickling filter columns were operated at three dosage rates, all in the standard or low rate range, to determine their operational characteristics and to facilitate comparison with similar filters used for ordinary sewage treatment. Due to its widespread usage in the sanitary engineering field, the biochemical oxygen demand (B.O.D.) test was used as the criterion for filter operation. Settled sewage, spiked with known amounts of radioactive iodine (I^{131}), was passed through the filter columns and the removal of activity determined at any one of six sampling points located at various filter depths. This arrangement provided data for the correlation of filter depth, dosage rate, and removal of activity. The results of 34 runs utilizing B.O.D. data are presented as well as the results of 15 runs employing radioactive sewage as a test material. The data indicated that the filters were operating normally with respect to B.O.D. removal and that I^{131} may be removed from certain contaminated wastes by treatment with trickling filters. When using a concentration of 1,000 counts per minute per milliliter (c/m/ml) of carrier-

free I^{131} removals of I^{131} in excess of 85% were obtained at a dosage rate of two million gallons per acre per day (mgad). (auth)

11346 THE PROBLEM OF HEAT GENERATION PRESENTED BY THE DISPOSAL OF LIQUID RADIOACTIVE WASTES IN DEEP GEOLOGICAL FORMATIONS. E. D. Mal'tsev, F. P. Yudin, V. S. Shamin, and P. F. Dolgikh. Atomnaya Energ., 12: 36-9(Jan. 1962). (In Russian)

In disposing or storing liquid radioactive waste materials in deep wells, salt mines, and similar deep geological formations, the heating of the medium presents a serious problem. This question was examined by calculating the heat generated in the layer, assuming a continuous flow of the waste effluents into it. A direct correlation was established between the temperature reached and the activity of the liquid; the porosity and the width of the vein also affect the top temperature. The activity of the waste liquids thus depends primarily on the permissible maximum temperature. An obvious upper limit is presented by the volatilization temperature of the liquid under the prevailing field conditions; another is determined by the physicochemical changes of the stratum which may affect the waste disposal process. In the calculations, the temperature of the incoming waste stream, heat transfer by convection, sorption and desorption of the radioactive materials on the mineral deposits, and radiolysis under evolution of gas were not taken into consideration. (TTT)

11347 DISPOSAL OF RADIOACTIVE WASTES IN THE OCEAN. Donald W. Pritchard (Johns Hopkins Univ., Baltimore). Health Phys., 6: 103-9(Oct. 1961).

Oceanographic problems associated with the peaceful uses of nuclear energy are outlined to indicate what is now known concerning the various pertinent physical, chemical, biological, and geological phenomena in the sea which determine the safe capacity of any segment of the sea to receive nuclear materials. A preliminary evaluation of the capacity of the ocean to receive nuclear materials safely is also presented. (auth)

11348 SOME LEGAL CONSIDERATIONS IN THE OCEAN DISPOSAL OF RADIOACTIVE WASTES. REMARKS. Robert Lowenstein (U. S. Atomic Energy Commission, Washington, D. C.). Health Phys., 6: 110-13(Oct. 1961).

After a brief review of the kind and number of licenses issued under the Atomic Energy Act of 1954, special attention is given to the principal legal problems of ocean disposal in the Gulf of Mexico case, Matter of Industrial Waste Disposal Corporation. The case was finally decided by the Commission during the first week in October, 1960. Discussion is also given on the four principal issues in the case. (P.C.H.)

11349 SURVIVAL OF WASTE CONTAINERS AT OCEAN DEPTHS. J. M. Brown, Jr., J. F. Thompson, and H. L. Andrews (National Institutes of Health, Bethesda, Md.). Health Phys., 7: 227-8(Feb. 1962).

Radioactive waste disposals have been made in the Atlantic Ocean at depths exceeding 6000 ft in an area about 80 mi east from the coast at Norfolk, Virginia, for over 10 years. Wastes were packaged in either 55-gal steel drums or in reinforced-concrete burial vaults. Tests were undertaken to determine the effects of high hydrostatic pressure on the two types of containers. Results indicate that concrete-filled containers remain essentially intact under the high hydrostatic pressures of ocean depths, and that metal containers resistant to corrosion should also provide isolation for long periods of time. (C.H.)

11350 TESTS CARRIED OUT ON ORGANIC CATION EXCHANGE RESINS FOR THE DECONTAMINATION OF AQUEOUS RADIOACTIVE EFFLUENTS. J. Bourdrez, J. Girault, G. Wormjer, and P. Cohen (Centre d'Études Nucléaires, Saclay, France). Health Phys., 7: 228(Feb. 1962).

Results are presented from tests on the effectiveness of organic cation exchange resins for the decontamination of aqueous radioactive effluents having low anion concentrations. The resins were in fixed-bed columns and were regenerated by NaCl solutions. The activity was recovered in a volume of eluent which was, on the average, 20 times smaller than that of the radioactive waste. This smaller volume was efficiently decontaminated by a two-stage chemical treatment. A flowsheet for a sample decontamination is included. (C.H.)

11351 EFFLUENT AT WINDSCALE AND THE EFFECT OF THE CIVIL POWER PROGRAMME. J. A. Williams and P. C. Davidge (United Kingdom Atomic Energy Authority, Rieley, Lancs, Eng.). J. Brit. Nuclear Energy Soc., 1: 14-29(Jan. 1962).

Over the next ten years the electrical power generated by British nuclear stations will rise to about twenty times that at present being generated by the UKAEA reactors at Calder Hall and Chapelcross, and the amount of fission product waste produced by the power stations will increase in proportion to the power generated. The methods of waste handling at present employed by the Atomic Energy Authority are described. The measures that are being taken to handle the waste from the expanding nuclear power program are outlined. (auth)

CORPORATE AUTHOR INDEX

This index contains entries for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt." This change permits a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

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Ö		oe
œ		oe
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12	16-10438	Dep.(mc)
ACNP–		
6107	16-11182	Dep.(mc), $2.60(fs), $0.98(mf) OTS
62001	16-11183	Dep.(mc); $8.60(fs), $3.08(mf) OTS
AD–	**(Misc.)**	
258398*	16-11066	See AFCRL-339
259156*	16-11067	See AFCRL-621
259157*	16-10660	See AFCRL-337
259174*	16-11068	See AFCRL-635
259175*	16-10810	See AFCRL-636
259452*	16-11064	OTS
259539*	16-10044	OTS
259663*	16-11111	$6.60(OTS)
259722*	16-10120	OTS
259821*	16-10164	OTS
259848*	16-10656	OTS
259858*	16-11065	OTS
259879*	16-11071	See GCA-TR-61-29-A
259882*	16-10450	OTS
260039*	16-10945	
260068*	16-11341	See WADD-TR-60-872
260280*	16-11072	See LMSD-894814
260331*	16-10657	
260357*	16-10658	See AFCRL-253
260361*	16-10659	See AFCRL-283
260365*	16-10661	See AFCRL-400
260366*	16-10675	See R61SD100
261745*	16-10662	See AFCRL-802
262643*	16-9729	See ASD-TR-61-60
266021*	16-10185	See GACD-2495
266275*	16-11338	See R61SD150
266336*	16-9920	See ASD-TR-61-221
267891*	16-10499	
AE–	**(Swedish)**	
63	16-10935	Dep.(mc)
AEC-tr–		
4450	16-9983	Dep.; $3.75(OTS)
4453	16-9984	Dep.; $3.75(OTS)
4455	16-9985	Dep.; $3.75(OTS)
4964	16-10310	Dep.(mc); $1.60(fs), $0.80(mf) JCL
4996	16-9813	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
4998	16-10152	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
5003	16-10458	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
5004	16-10198	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
5010	16-10680	Dep.(mc); $1.10(fs), $0.80(mf) JCL
5017	16-9986	Dep.(mc); $1.10(fs), $0.80(mf) JCL
AECL–	**(Canadian)**	
1207	16-10360	See AECL-1329(p.42-7)
1208	16-10361	See AECL-1329(p.48-55)
1260	16-10358	See AECL-1329(p.29-37)
1329	16-10354	Dep.; $1.00(AECL)
1329(p.13-16)	16-10355	Brit. Columbia Orchardist 1: No. 4 (1960)
1329(p.25-8)	16-10357	J. Food Sci. 26: 153-5(1961)
1329(p.29-37)	16-10358	Can. J. Public Health 52: 232-40(1961)
1329(p.38-41)	16-10359	Appl. Microbiol. 8: 311-14(1960)
1329(p.42-7)	16-10360	Can. J. Microbiol. 7: 199-205(1961)
1329(p.48-55)	16-10361	Can. J. Microbiol. 7: 207-15(1961)
1329(p.69-72)	16-10363	Can. J. Microbiol. 7: 135-9(1961)
1329(p.73-90)	16-10364	Can. J. Phys. 39: 514-33(1961)
1406	16-10166	See CREL-781
1410	16-10380	See CRT-867
1411	16-10507	See CRT-1049
1414	16-11316	See CRRP-1045
1416	16-10045	See CRC-1066
1417	16-10167	See CREL-1063
1418	16-10430	See CRRM-1065
1422	16-10987	Can. J. Phys. 40: 194-201(1962)
1425	16-10988	Can. J. Phys. 40: 296-9(1962)
1429	16-10214	Can. J. Phys. 40: 237-56(1962)
1430	16-10215	Can. J. Phys. 40: 257-73(1962)
1439	16-9942	See CRDC-732
AEDC-TDR–	**(Non-AEC)**	
62-51	16-10121	
AEEW-M–	**(British)**	
102	16-10122	Dep.; $0.35(BIS)
AERE-R–	**(British)**	
3614	16-10014	J. Inorg. & Nuclear Chem. 20: 295-9 (1961)
3839	16-9741	Dep.; $1.68(BIS)
AERE-Trans–	**(British)**	
880	16-10819	Dep.
AFCRL–	**(Non-AEC)**	
198	16-11072	See LMSD-894814
253	16-10658	OTS
283	16-10659	OTS
337	16-10660	OTS
339	16-11066	OTS
400	16-10661	OTS
621	16-11067	OTS
635	16-11068	OTS
636	16-10810	OTS
802	16-10662	
AFOSR–	**(Misc.)**	
687*	16-80	See R61SD100
1551*	16-11069	OTS
1595*	16-11338	See R61SD150
1842*	16-10663	
1864*	16-11070	
1890*	16-10811	
1998*	16-11078	See USCEC-79-101
2040*	16-10664	
2045*	16-10665	
AHSB(S)–	**(British)**	
R-18	16-10294	Dep.; $0.42(BIS)
Al–	**(Misc.)**	
5272	16-11184	Dep.(mc); $6.60(fs), $2.27(mf) OTS
ALI-C–	**(Misc.)**	
61378	16-10194	See TID-15005
ANL–		
6451	16-11313	Dep.; $2.75(OTS)
6470	16-10272	Dep.; $3.00(OTS)
6484	16-11185	Dep.; $0.50(OTS)
6487	16-10804	Dep.; $0.50(OTS)
6494	16-11186	Dep.; $0.50(OTS)
6509	16-11187	Dep.; $1.50(OTS)
APAE–	**(Misc.)**	
109	16-10295	Dep.(mc); $2.60(fs), $0.83(mf) OTS
APAE-Memo–	**(Misc.)**	
302	16-11188	Dep.(mc); $3.60(fs), $1.19(mf) OTS
APEX–		
614	16-10547	Dep.; $0.75(OTS)
656	16-10261	Dep.; $0.50(OTS)
663	16-10377	Dep.; $3.00(OTS)
664	16-10378	Dep.; $3.50(OTS)
666(Pt.1)	16-11189	Dep.; $3.00(OTS)
666(Pt.2)	16-10123	Dep.; $0.50(OTS)
671	16-10604	Dep.; $1.00(OTS)
672	16-10500	Dep.; $1.50(OTS)
676	16-10605	Dep.; $1.00(OTS)
684	16-10501	Dep.; $1.00(OTS)
702	16-10379	Dep.; $3.00(OTS)
704	16-10946	Dep.; $2.75(OTS)
716	16-11314	Dep.; $2.00(OTS)
AROD–	**(Misc.)**	
2287.15*	16-10502	
2319.3*	16-11138	
2810.4*	16-10947	
ASD-TR–	**(Non-AEC)**	

Report No.	Abstract No.	Availability
7-532a(V)	16-10469	
7-784(VI)	16-10470	
61-60	16-9729	OTS
61-73	16-10503	OTS
61-73(Pt.II)	16-10504	OTS
61-221	16-9920	$0.50(OTS)
61-322	16-10399	OTS
61-440	16-10505	OTS
AWRE-O–	**(British)**	
50/61	16-10296	
AWRE-Trans–	**(British)**	
29	16-10311	Dep.(mc); $1.60(fs), $0.80(mf) JCL
BAW–	**(Misc.)**	
1240	16-11190	Dep.; $2.50(OTS)
BC–	**(Misc.)**	
17*	16-10528	See HMI-B-19
BL–	**(Non-AEC)**	
21	16-10044	See AD-259539
BM-IC–	**(Non-AEC)**	
8039	16-9940	$0.35(GPO)
BM-RI–	**(Misc.)**	
5916*	16-10093	Free; Bureau of Mines
5917*	16-10094	Free; Bureau of Mines
5934*	16-10429	Free; Bureau of Mines
5941*	16-10096	Free; Bureau of Mines
BMI–	**(Misc.)**	
1567	16-10471	Dep.; $0.50(OTS)
BMI-X–		
189	16-10366	Dep.(mc); $1.60(fs), $0.80(mf) OTS
191	16-10506	Dep.(mc); $2.60(fs), $1.01(mf) OTS
BNL–		
4590	16-10091	p. 416-24 of "Reactivity of Solids. Proceedings of the Fourth International Symposium on the Reactivity of Solids, Amsterdam, 1960." Amsterdam, Elsevier Publishing Co.
4665	16-10090	p. 334-44 of "Reactivity of Solids. Proceedings of the Fourth International Symposium on the Reactivity of Solids, Amsterdam, 1960." Amsterdam, Elsevier Publishing Co.
4999	16-9891	p. 1460-5 of "Recent Advances in Botany" Toronto, University of Toronto Press, 1961
5315	16-10234	IRE Intern. Conv. Record 9: Pt. 9, 87-96(1961)
5565	16-10002	J. Chem. Phys. 35: 2265-6(1961)
5576	16-10071	J. Phys. Chem. 66: 262-6(1962)
5578	16-11016	Phys. Rev. 124: 1186-9(1962)
5721	16-11023	Phys. Rev. 125: 968-71(1962)
5763	16-9882	Nature 193, 792-3(1962)
5879	16-9742	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6520	16-9935	J. Chem. Phys. 35: 2266-7(1961)
BS–		
1033	16-10452	See EURAEC-31
CEA–	**(French)**	
1999	16-9941	Dep.(mc)
2034	16-10273	Dep.
CEND–	**(Misc.)**	
141	16-11139	Dep.; $2.50(OTS)
147	16-11191	Dep.; $1.25(OTS)
1009	16-11192	Dep.; $2.25(OTS)
CERN–	**(Non-AEC)**	
61-30	16-10812	Dep.(mc)
61-31	16-10165	Dep.(mc)
62-2	16-10813	Dep.(mc)
CEX–		
59-7C	16-10297	Dep.; $0.50(OTS)
60.5	16-10298	Dep.; $0.50(OTS)
60.6	16-9730	Dep.; $1.00(OTS)
CM–	**(Misc.)**	
985*	16-10188	See NP-11314
CNEN–	**(Italian)**	
101	16-11315	Dep.(mc)
CRC–	**(Canadian)**	
1066	16-10045	Dep.; $1.00(AECL)
CRDC–	**(Canadian)**	
732	16-9942	Dep.; $0.50(AECL)
CREL–	**(Canadian)**	
781	16-10166	Dep.; $1.00(AECL)
1063	16-10167	Dep.; $1.00(AECL)
CRRH–	**(Canadian)**	
1065	16-10430	Dep.; $0.50(AECL)
CRRP–	**(Canadian)**	
1045	16-11316	Dep.; $1.50(AECL)
CRT–	**(Canadian)**	
867	16-10380	Dep.; $2.00(AECL)
1049	16-10507	Dep.; $1.50(AECL)
DC–	**(Misc.)**	
55-5-16	16-10472	Dep.(mc); $1.60(fs), $0.80(mf) OTS
55-5-17	16-10508	Dep.(mc); $3.60(fs), $1.19(mf) OTS
55-5-87	16-10299	Dep.(mc); $1.10(fs), $0.80(mf) OTS
55-5-90	16-10606	Dep.(mc); $9.10(fs), $3.41(mf) OTS
55-6-55	16-11112	$3.60(fs), $1.40(mf) OTS
55-6-101	16-10607	Dep.(mc); $2.60(fs), $0.89(mf) OTS
55-6-133	16-11140	Dep.(mc); $1.60(fs), $0.80(mf) OTS
55-7-96	16-11141	Dep.(mc); $3.60(fs), $1.19(mf) OTS
55-8-109	16-11193	Dep.(mc); $1.10(fs), $0.80(mf) OTS
55-11-17	16-11194	Dep.(mc); $1.60(fs), $0.80(mf) OTS
55-12-110	16-11195	Dep.(mc); $1.60(fs), $0.80(mf) OTS
56-3-115	16-10509	$1.10(fs), $0.80(mf) OTS
56-5-157	16-11142	Dep.(mc); $1.60(fs), $0.80(mf) OTS
56-12-37	16-11196	Dep.(mc); $4.60(fs), $1.43(mf) OTS
56-12-104	16-10124	Dep.(mc); $2.60(fs), $0.83(mf) OTS
56-12-105	16-10381	Dep.(mc); $3.60(fs), $1.25(mf) OTS
57-1-18	16-11143	Dep.(mc); $1.60(fs), $0.85(mf) OTS
57-1-19	16-10382	Dep.(mc); $1.60(fs), $0.85(mf) OTS
57-1-55	16-10146	Dep.(mc); $3.60(fs), $1.40(mf) OTS
57-1-75	16-10948	Dep.(mc); $1.10(fs), $0.80(mf) OTS
57-1-95	16-11197	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-1-103	16-10168	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-2-76	16-10169	Dep.(mc); $4.60(fs), $1.55(mf) OTS
57-2-129	16-10949	Dep.(mc); $16.50(fs), $7.97(mf) OTS
57-3-19	16-10510	Dep.(mc); $2.60(fs), $1.10(mf) OTS
57-3-164	16-10473	Dep.(mc); $3.60(fs), $1.25(mf) OTS
57-4-25	16-10474	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-6-87	16-10475	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-7-98	16-10170	Dep.(mc); $7.60(fs), $2.54(mf) OTS
57-8-83	16-11113	Dep.(mc); $1.10(fs), $0.80(mf) OTS
57-8-158	16-11114	Dep.(mc); $1.10(fs), $0.80(mf) OTS
57-9-32	16-11198	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-9-107	16-11199	Dep.(mc); $8.60(fs), $3.05(mf) OTS
57-10-39	16-11144	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-10-46	16-11115	Dep.(mc); $9.10(fs), $3.29(mf) OTS
57-11-65	16-11145	Dep.(mc); $1.60(fs), $0.80(mf) OTS
57-11-77	16-11116	Dep.(mc); $2.60(fs), $1.07(mf) OTS
57-11-101	16-11117	Dep.(mc); $8.60(fs), $2.93(mf) OTS
57-11-103	16-11118	Dep.(mc); $1.10(fs), $0.80(mf) OTS
57-11-176	16-11200	Dep.(mc); $3.60(fs), $1.25(mf) OTS
57-11-195	16-10171	Dep.(mc); $3.60(fs), $1.31(mf) OTS
57-11-718	16-10608	Dep.(mc); $2.60(fs), $1.01(mf) OTS
58-1-1	16-11201	Dep.(mc); $5.60(fs), $1.73(mf) OTS
58-4-54	16-10666	Dep.(mc); $1.60(fs), $0.80(mf) OTS
58-4-121	16-11119	Dep.(mc); $8.10(fs), $2.66(mf) OTS
58-4-128	16-10383	Dep.(mc); $6.60(fs), $2.27(mf) OTS
58-5-132	16-11120	Dep.(mc); $10.50(fs), $4.31(mf) OTS
58-5-179	16-10609	Dep.(mc); $2.60(fs), $0.86(mf) OTS
58-7-45	16-10511	Dep.(mc); $2.60(fs), $0.98(mf) OTS
58-8-708	16-10384	Dep.(mc); $1.60(fs), $0.80(mf) OTS
58-9-198	16-10936	Dep.(mc); $2.60(fs), $0.83(mf) OTS
59-1-89	16-10385	Dep.(mc); $4.60(fs), $1.70(mf) OTS
59-1-153	16-11202	Dep.(mc); $2.60(fs), $0.95(mf) OTS

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59-2-101	16-10172	Dep.(mc); $19.75(fs), $9.45(mf) OTS
59-4-199	16-10950	Dep.(mc); $2.60(fs), $1.01(mf) OTS
59-5-16	16-10173	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-5-210	16-10512	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-8-37	16-11121	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-8-217	16-10386	Dep.(mc); $5.60(fs), $1.97(mf) OTS
59-10-185	16-10610	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-10-707	16-11203	Dep.(mc); $9.10(fs), $3.23(mf) OTS
59-10-745	16-10300	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-10-749	16-11204	Dep.(mc); $1.10(fs), $0.80(mf) OTS
59-11-3	16-11205	Dep.(mc); $1.10(fs), $0.80(mf) OTS
59-11-5	16-10611	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-11-29	16-10174	Dep.(mc); $6.60(fs), $2.15(mf) OTS
59-11-73	16-10805	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-11-85	16-11206	Dep.(mc); $5.60(fs), $2.00(mf) OTS
59-11-158	16-10806	Dep.(mc); $1.10(fs), $0.80(mf) OTS
59-11-160	16-10612	Dep.(mc); $3.60(fs), $1.40(mf) OTS
59-11-162	16-10513	Dep.(mc); $2.60(fs), $1.04(mf) OTS
59-11-164	16-10125	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-11-196	16-10613	Dep.(mc); $3.60(fs), $1.16(mf) OTS
59-12-28	16-10126	Dep.(mc); $2.60(fs), $1.04(mf) OTS
59-12-36	16-10175	Dep.(mc); $1.10(fs), $0.80(mf) OTS
59-12-82	16-10387	Dep.(mc); $4.60(fs), $1.46(mf) OTS
59-12-123	16-10388	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-12-183	16-11329	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-12-221	16-10951	Dep.(mc); $1.60(fs), $0.80(mf) OTS
59-12-229	16-11122	Dep.(mc); $6.60(fs), $2.15(mf) OTS
60-1-106	16-10667	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-1-159	16-10389	Dep.(mc); $2.60(fs), $1.01(mf) OTS
60-1-168	16-10952	Dep.(mc); $2.60(fs), $0.92(mf) OTS
60-2-22	16-11207	Dep.(mc); $8.10(fs), $2.90(mf) OTS
60-2-79	16-10937	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-2-84	16-11208	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-2-112	16-10514	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-2-145	16-10176	Dep.(mc); $3.60(fs), $1.31(mf) OTS
60-2-163	16-10177	Dep.(mc); $3.60(fs), $1.37(mf) OTS
60-2-210	16-10515	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-2-212	16-10476	Dep.(mc); $2.60(fs), $1.10(mf) OTS
60-2-215	16-10668	Dep.(mc); $2.60(fs), $1.07(mf) OTS
60-2-295	16-11146	Dep.(mc); $1.10(fs), $0.80(mf) OTS
60-3-35	16-10516	Dep.(mc); $3.60(fs), $1.34(mf) OTS
60-3-124	16-11209	Dep.(mc); $8.10(fs), $2.81(mf) OTS
60-3-166	16-10178	Dep.(mc); $2.60(fs), $1.07(mf) OTS
60-3-226	16-10179	Dep.(mc); $3.60(fs), $1.28(mf) OTS
60-3-244	16-10614	Dep.(mc); $2.60(fs), $0.98(mf) OTS
60-4-22	16-11210	Dep.(mc); $5.60(fs), $2.00(mf) OTS
60-4-63	16-11211	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-4-80	16-10517	Dep.(mc); $1.10(fs), $0.80(mf) OTS
60-4-84	16-10615	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-4-108	16-11123	Dep.(mc); $12.00(fs), $5.06(mf)
60-4-171	16-10180	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-4-174	16-11212	Dep.(mc); $2.60(fs), $1.10(mf) OTS
60-5-45	16-10181	Dep.(mc); $9.60(fs), $3.53(mf) OTS
60-5-727	16-10953	Dep.(mc); $2.60(fs), $0.95(mf) OTS
60-6-37	16-10127	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-6-53	16-11213	Dep.(mc); $2.60(fs), $0.98(mf) OTS
60-6-57	16-10431	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-6-125	16-10451	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-6-712	16-10182	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-6-735	16-11214	Dep.(mc); $18.00(fs), $8.84(mf) OTS
60-7-31	16-11215	Dep.(mc); $2.60(fs), $1.07(mf) OTS
60-7-706	16-10183	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-11-165	16-10518	Dep.(mc); $8.60(fs), $2.93(mf) OTS
60-12-26	16-10184	Dep.(mc); $4.60(fs), $1.67(mf) OTS
DCL–		
59-8-93	16-10519	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-1-72	16-10616	Dep.(mc); $1.10(fs), $0.80(mf) OTS
60-1-73	16-11216	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DEG-Report–	**(British)**	
292	16-10617	Dep.; $0.42(BIS)
DLCS–		
12003	16-9849	OTS
1470107	16-11217	Dep.(mc); $2.60(fs), $0.86(mf) OTS
3590601	16-11218	Dep.(mc); $3.60(fs), $1.37(mf) OTS
4000201	16-11219	Dep.(mc); $2.60(fs), $0.86(mf) OTS
DMIC–	**(Non-AEC)**	
162	16-10520	
DMIC-Memo–	**(Non-AEC)**	
146	16-10521	
DP–		
607	16-10522	Dep.; $0.50(OTS)
622	16-10523	Dep.; $0.50(OTS)
695	16-11220	Dep.; $0.50(OTS)
DUBNA REPORTS		**(Russian)**
See JINR (Russian)		
EFINS–	**(Misc.)**	
61-17	16-10669	Dep.(mc); $1.60(fs), $0.80(mf) OTS
61-68	16-10954	Dep.(mc); $3.60(fs), $1.22(mf) OTS
EOS–	**(Non-AEC)**	
1592-Final	16-10524	
1592-2M-3	16-10432	
1592-2M-4	16-10433	
ERR-SD–	**(Non-AEC)**	
135	16-11330	
EURAEC–		
14	16-10477	Dep.(mc); $2.60(fs), $0.86(mf) OTS
15	16-10478	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16	16-10479	Dep.(mc); $2.60(fs), $1.07(mf) OTS
21	16-10525	Dep.(mc); $4.60(fs), $1.49(mf) OTS
31	16-10452	Dep.(mc); $5.60(fs), $1.88(mf) OTS
50	16-10128	Dep.(mc); $1.60(fs), $0.80(mf) OTS
55	16-10434	Dep.(mc); $6.60(fs), $2.30(mf) OTS
81	16-10097	Dep.(mc); $8.60(fs), $3.17(mf) OTS
83	16-11342	Dep.(mc); $4.60(fs), $1.70(mf) OTS
86	16-10526	Dep.(mc); $8.10(fs), $2.66(mf) OTS
109	16-9943	Dep.(mc); $1.10(fs), $0.80(mf) OTS
FIL–	**(Non-AEC)**	
1-R	16-11064	See AD-259452
FPL–	**(Non-AEC)**	
1883	16-10538	See NP-11400
FTD-TT–	**(Non-AEC)**	
61-92	16-11079	OTS
61-175	16-10965	OTS
61-251	16-10488	OTS
61-285	16-10548	OTS
61-350	16-10681	OTS
61-400	16-10682	OTS
62-43	16-11080	OTS
62-52	16-10153	OTS
62-55	16-10154	OTS
62-57	16-10155	OTS
62-58	16-10156	OTS
62-61	16-10157	OTS
62-62	16-10158	OTS
62-69	16-10159	OTS
FZK–	**(Non-AEC)**	
9-172	16-10938	See NARF-61-43T
GA–	**(Misc.)**	
2477*	16-11251	p. 79-101 of "Power Reactor Experi- Atomic Energy Agency, 1962 ments. Vol. I." Vienna, International
2492	16-10390	Dep.(mc); $9.60(fs), $3.59(mf) OTS
2493	16-11221	Dep.; $3.00(OTS)
2691	16-10480	Dep.; $0.75(OTS)
GACD–	**(Non-AEC)**	
2495	16-10185	
GAMD–	**(Misc.)**	
1059	16-10527	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GAT-T–		
816	16-10129	Dep.; $0.50(OTS)
GCA-TR–	**(Non-AEC)**	
61-29-A	16-11071	OTS

Report No.	Abstract No.	Availability
GEAP–	**(Misc.)**	
3528(Rev.1)	16-11222	Dep.; $2.75(OTS)
3775	16-10481	Dep.; $1.75(OTS)
3796	16-11223	Dep.; $1.75(OTS)
GEMP–		
102	16-11124	Dep.; $2.50(OTS)
GNE-Phys.–	**(Non-AEC)**	
61-2	16-11111	See AD-259663
61-12	16-10120	See AD-259722
HMI-B–	**(German)**	
19	16-10528	Dep.(mc)
HPR–	**(Norwegian)**	
14	16-11224	Dep.(mc)
16	16-11225	Dep.(mc)
HW–		
63261	16-9944	Dep.; $2.60(fs), $0.86(mf) OTS
66882	16-10807	Dep.; $1.25(OTS)
67792	16-11226	Dep.; $1.00(OTS)
68954(Rev.I)	16-10098	Dep.(mc); $1.60(fs), $0.80(mf) OTS
69594	16-11147	Dep.(mc); $1.60(fs), $0.80(mf) OTS
69632	16-11311	Dep.(mc); $2.60(fs), $1.10(mf) OTS
69808	16-10808	Dep.; $1.00(OTS)
70607	16-10529	Dep.; $2.60(fs), $0.83(mf) OTS
70919	16-10262	Dep.(mc); $2.60(fs), $0.92(mf) OTS
71279	16-11227	Dep.(mc); $2.60(fs), $0.83(mf) OTS
71314	16-10130	Dep.; $0.50(OTS)
71435	16-9945	Dep.(mc); $1.10(fs), $0.80(mf) OTS
71743	16-10301	Dep.(mc); $1.60(fs), $0.80(mf) OTS
71794	16-10530	Dep.; $1.00(OTS)
71812	16-10391	Dep.; $1.75(OTS)
72217	16-11312	Dep.; $2.75(OTS)
72608	16-9946	Dep.(mc); $1.10(fs), $0.80(mf) OTS
72679	16-11228	Dep.(mc); $1.10(fs), $0.80(mf) OTS
HW-SA–		
2134	16-10497	See STI/PUB/15/20
2257	16-11278	p. 213-27 of "Power Reactor Experiments. Vol. II." Vienna, International Atomic Energy Agency, 1962.
2293	16-10583	Trans. Met. Soc. AIME 224: 200-1(1962)
IA–	**(Non-AEC)**	
699	16-10186	Dep.(mc)
IDO–		
14559	16-10099	Dep.; $1.00(OTS)
16743	16-11148	Dep.; $2.75(OTS)
19024	16-11192	See CEND-1009
19302	16-10302	Dep.; $2.00(OTS)
INSJ–	**(Japanese)**	
47	16-10955	Dep.(mc)
IS–		
210	16-10026	J. Phys. Chem. 66: 311-14(1962)
280	16-10578	Trans. Am. Soc. Metals 54: 580-90(1961)
286	16-10100	Dep.; $1.75(OTS)
331	16-9933	Dep.; $1.50(OTS)
389	16-10733	Phys. Rev. Letters 8: 164-5(1962)
ITEP–	**(Russian)**	
30-61	16-10817	See NP-11301
31-61	16-10816	See NP-11300
JINR–	**(Russian)**	
D-694	16-10956	Dep.(mc)
D-793	16-10814	Dep.(mc)
P-826	16-10957	Dep.(mc)
P-831	16-10815	Dep.(mc)
P-836	16-10670	Dep.(mc)
JPL-TR–	**(Non-AEC)**	
32-160	16-11331	
32-181	16-10531	
JPRS–	**(Non-AEC)**	
11485	16-9846	OTS
11811	16-9736	OTS
12161	16-11161	OTS
12166	16-10312	OTS
12183	16-11237	$2.00(OTS)
12188	16-10199	OTS
12305	16-10369	OTS
12310	16-9921	OTS
12387	16-9850	OTS
12674	16-10397	OTS
JÜL–	**(German)**	
23-RX	16-11317	Dep.(mc)
24-RX	16-11318	Dep.(mc)
25-RX	16-11319	Dep.(mc)
K–		
1455	16-10372	Dep.(mc); $7.60(fs), $2.48(mf) OTS
KAPL–		
2180	16-10131	Dep.; $1.50(OTS)
LA–		
2654	16-11149	Dep.; $2.25(OTS)
2656	16-11332	Dep.; $2.60(fs), $1.07(mf) OTS
LAMS–		
2628	16-10671	Dep.; $0.50(OTS)
LM-TAB–	**(Non-AEC)**	
19	16-10532	
LMSD–	**(Non-AEC)**	
894814	16-11072	OTS
MATT–		
93	16-11101	Phys. Rev. 125: 795-801(1962)
MF–	**(Misc.)**	
25	16-11074	See NYO-9600
MND-MD–		
2560-1	16-11229	Dep.; $2.00(OTS)
2560-3	16-11230	Dep.(mc); $11.00(fs), $4.43(mf) OTS
MPR-XIII–		
1-62	16-10148	See TID-14993
MRL–	**(Non-AEC)**	
110	16-10672	
MURA–	**(Misc.)**	
432	16-11046	Dep.(mc); $1.60(fs), $0.80(mf) OTS
458	16-11047	Dep.(mc); $1.60(fs), $0.80(mf) OTS
464	16-11048	Dep.(mc); $1.10(fs), $0.80(mf) OTS
495	16-11049	Dep.(mc); $1.60(fs), $0.80(mf) OTS
496	16-11050	Dep.(mc); $2.60(fs), $0.89(mf) OTS
511	16-11051	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NAA-SR–		
5700	16-10303	Dep.(mc); $22.25(fs), $9.97(mf) OTS
5700(Suppl.1)	16-10304	Dep.(mc); $3.60(fs), $1.13(mf) OTS
5700(Suppl.2)	16-10305	Dep.(mc); $8.10(fs), $2.78(mf) OTS
5700(Suppl.3)	16-10306	Dep.(mc); $10.50(fs), $4.34(mf) OTS
5700(Suppl.4)	16-10307	Dep.(mc); $17.00(fs), $8.06(mf) OTS
6527	16-11231	Dep.; $0.75(OTS)
6550	16-10673	J. Appl. Phys., 33: 629-33(1962)
6551	16-10533	J. Appl. Phys., 33: 634-41(1962)
6616	16-11232	Dep.; $1.00(OTS)
6642	16-10618	Dep.; $1.00(OTS)
6674	16-10453	Dep.; $0.50(OTS)
NARF–	**(Non-AEC)**	
61-43T	16-10938	
NAS-NS–	**(Misc.)**	
3051	16-10046	Dep.; $0.50(OTS)
3052	16-10047	Dep.; $0.75(OTS)
3053	16-10048	Dep.; $0.50(OTS)
3054	16-10049	Dep.; $0.50(OTS)
NASA-TN–	**(Misc.)**	
D-1123*	16-11333	$0.50(OTS)
D-1166*	16-11334	$1.00(OTS)
D-1193*	16-10619	$0.50(OTS)
NAVORD–	**(Non-AEC)**	
6878	16-11073	
NAVWEPS–	**(Non-AEC)**	
7205	16-10674	
NBS-MON–	**(Misc.)**	
27*	16-10187	$0.15(GPO)
NBS-TN–	**(Non-AEC)**	

Report No.	Abstract No.	Availability
75	16-11052	$1.25 OTS as PB-161576
NEVIS–	**(Misc.)**	
99*	16-10958	
NMI–	**(Misc.)**	
2100	16-10435	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2102	16-10534	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7210	16-11150	Dep.(mc); $4.60(fs), $1.46(mf) OTS
7242	16-11233	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NP–	**(AEC File No. for Non-AEC Reports)**	
10640(Suppl.I)	16-10535	OTS
11300	16-10816	Dep.(mc)
11301	16-10817	Dep.(mc)
11303	16-10308	
11305	16-9743	
11312	16-10454	
11314	16-10188	
11344	16-11335	
11347	16-10482	
11355	16-10959	
11356	16-10536	
11357	16-9731	
11370	16-10620	
11385	16-11336	
11387	16-10537	
11388	16-9977	
11390	16-10818	Dep.(mc)
11400	16-10538	
11402	16-10539	
11404	16-11337	
11405	16-10132	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
821	16-10489	OTS
846	16-10370	Dep.(mc); $1.60(fs), $0.80(mf) JCL
848	16-9851	Dep.(mc); $3.60(fs), $1.28(mf) JCL
NR–	**(Misc.)**	
130	16-10267	See SRO-54
NRC–	**(Canadian)**	
6243	16-10357	See AECL-1329(p.25-8)
NSF–	**(Misc.)**	
62-35(1)	16-10969	Dep.(mc); $4.60(fs), $1.55(mf) JCL or OTS
62-35(2)	16-10459	Dep.(mc); $2.60(fs), $0.83(mf) JCL or OTS
62-35(3)	16-11081	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
62-35(4)	16-11082	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
62-35(5)	16-10263	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
NUMEC-P–		
36	16-11151	Dep.(mc); $1.10(fs), $0.80(mf) OTS
37	16-10540	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NYO–		
2607	16-10367	Dep.; $1.25(OTS)
2996	16-11191	See CEND-147
9012	16-11139	See CEND-141
9451	16-10876	Phys. Rev. 125: 1028-33(1962)
9586	16-10483	Dep.; $1.25(OTS)
9587	16-11152	Dep.; $1.00(OTS)
9600	16-11074	Dep.(mc); $3.60(fs), $1.28(mf) OTS
10007	16-10484	Dep.; $0.50(OTS)
ORINS–		
39	16-9838	Dep.(mc); $1.75(OTS)
ORNL–		
3198	16-10392	Dep.; $1.00(OTS)
3199	16-10393	Dep.; $1.00(OTS)
3200	16-10394	Dep.; $1.00(OTS)
3220(Pt.I)	16-10101	Dep.; $0.50(OTS)
3222	16-10621	Dep.; $1.75(OTS)
3229	16-10939	Dep.; $1.00(OTS)
3231	16-11234	Dep.; $1.50(OTS)
3246	16-11075	Dep.; $0.50(OTS)
3249	16-11235	Dep.; $0.50(OTS)
3252	16-10264	Dep.; $3.60(fs), $1.37(mf) OTS
3253	16-10455	Dep.; $0.75(OTS)
ORNL-TM–		
65	16-10102	Dep.(mc); $8.60(fs), $3.05(mf) OTS
103	16-10265	Dep.(mc); $1.60(fs), $0.80(mf) OTS
106	16-11236	Dep.(mc); $8.60(fs), $2.96(mf) OTS
127	16-11343	Dep.(mc); $4.60(fs), $1.55(mf) OTS
128	16-10133	Dep.(mc); $2.60(fs), $0.83(mf) OTS
149	16-10103	Dep.(mc); $7.60(fs), $2.60(mf) OTS
ORO–		
482	16-10189	Dep.; $0.50(OTS)
501	16-11153	Dep.; $2.00(OTS)
524	16-10541	Dep.(mc); $1.10(fs), $0.80(mf) OTS
PATENTS	**(British)**	**3s. 6d. each, U.K. Patent Office**
889,234	16-11106	
889,294	16-10655	
889,307	16-10095	
889,351	16-10448	
889,388	16-11173	
889,424	16-11310	
889,427	16-10449	
889,465	16-11107	
889,477	16-10138	
889,536	16-11174	
889,554	16-10115	
889,636	16-11175	
889,674	16-10116	
889,702	16-11176	
889,758	16-11177	
889,775	16-10042	
889,890	16-11108	
889,902	16-11178	
889,923	16-10139	
890,061	16-10140	
890,145	16-10092	
890,330	16-11179	
890,410	16-10117	
890,442	16-10141	
890,520	16-11180	
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,024,009	16-10142	
3,024,172	16-10118	
3,024,181	16-11181	
3,024,182	16-11109	
3,024,965	16-10143	
3,025,143	16-10119	
3,025,162	16-10260	
3,025,371	16-10144	
3,025,429	16-11110	
3,025,442	16-10145	
3,027,143	16-10163	
3,027,391	16-10043	
PB–	**(Non-AEC)**	
161576	16-11052	See NBS-TN-75
PG-Report–	**(British)**	
282	16-9947	Dep.; $0.25(BIS)
283	16-9948	Dep.; $0.21(BIS)
287	16-9949	Dep.; $0.25(BIS)
290	16-9950	Dep.
297	16-9951	Dep.
299	16-9952	Dep.
300	16-9953	Dep.
PM-I–	**(Canadian)**	
60-8	16-10482	See NP-11347
PNE–		
108P	16-10274	Dep.; $1.75(OTS)
111P	16-10275	Dep.; $1.50(OTS)
PPAD–		
419F	16-10190	Dep.; $2.00(OTS)
435D	16-10191	Dep.(mc); $2.60(fs), $1.01(mf) OTS
PST-Cat.–	**(Misc.)**	
372	16-9983	See AEC-tr-4450
375	16-9984	See AEC-tr-4453
377	16-9985	See AEC-tr-4455

Report No.	Abstract No.	Availability
PUC–		
1961-38	16-11014	Phys. Rev. 124: 1162-78(1962)
1961-46	16-11024	Phys. Rev. 125: 975-87(1962)
QMFCI–	**(Non-AEC)**	
14-61	16-10368	
R–	**(Misc.)**	
61SD100*	16-10675	
61SD150*	16-11338	
RADC-TN–	**(Non-AEC)**	
61-127	16-11071	See GCA-TR-61-29-A
RFP–		
108	16-10809	Dep.(mc); $1.60(fs), $0.85(mf) OTS
RME–		
4525(Rev.)	16-10276	Dep.; $0.50(OTS)
RTI–		
2513-T4-1	16-10189	See ORO-482
S–	**(Misc.)**	
32	16-10298	See CEX-60.5
SB–	**(Non-AEC)**	
61-35(Suppl.I)	16-10535	See NP-10640(Suppl.I)
441(Rev.)	16-10498	$0.10(OTS)
SC–	**(Misc.)**	
4482(RR)	16-10277	Dep.(mc); $7.60(fs), $2.36(mf) OTS
4645(RR)	16-9732	Dep.(nc); $1.60(fs), $0.80(mf) OTS
4669(RR)	16-10676	Dep.(nc); $11.50(fs), $4.94(mf) OTS
SCR–		
214	16-9733	Dep.(nc); $5.60(fs), $1.76(mf) OTS
456	16-10266	Dep.; $0.50(OTS)
SEP–		
259	16-10485	Dep.; $0.50(OTS)
SL–	**(Misc.)**	
1857-7	16-11154	$3.60(fs), $1.19(mf) OTS
SR–	**(Misc.)**	
41*	16-10132	See NP-11405
SRO–		
54	16-10267	Dep.; $2.00(OTS)
STI-PUB–	**(International Atomic Energy Agency)**	
15/20	16-10497	$1.00(IAEA)
51(Vols.I&II)	16-11248	$6.00(Vol.I); $4.00(Vol.II) (IAEA)
STL-TR–	**(Misc.)**	
60-0000-00078	16-11339	See UCRL-5916
TDR–	**(Non-AEC)**	
594(1203-01)TR-2	16-11065	See AD-259858
TEI–		
803	16-10278	Dep.(nc); $5.60(fs), $1.97(mf) OTS
TID–		
5059(5th Rev.)	16-9734	Dep.; $2.50(OTS)
13942	16-11344	Dep.; $1.50(OTS)
14302	16-11076	$1.60(fs), $0.80(mf) OTS
14558	16-11125	Dep.; $0.50(OTS)
14662	16-9839	Dep.(nc); $1.60(fs), $0.80(mf) OTS
14740	16-10542	Dep.(nc); $8.10(fs), $2.72(mf) OTS
14773	16-10543	Dep.(nc); $2.60(fs), $0.86(mf) OTS
14811	16-9954	Dep.(nc); $5.60(fs), $1.82(mf) OTS
14825	16-10147	Dep.(nc); $1.60(fs), $0.80(mf) OTS
14863	16-10192	Dep.(nc); $16.50(fs), $7.94(mf) OTS
14865	16-10960	Dep.(nc); $9.60(fs), $3.80(mf) OTS
14867	16-11345	Dep.(nc); $8.60(fs), $3.20(mf) OTS
14868	16-10961	Dep.(nc); $10.50(fs), $4.22(mf) OTS
14869	16-10962	Dep.(nc); $2.60(fs), $0.92(mf) OTS
14880	16-10963	Dep.(nc); $7.60(fs), $2.36(mf) OTS
14949	16-9978	Dep.(nc); $1.10(fs), $0.80(mf) OTS
14952	16-9744	Dep.(nc); $2.60(fs), $0.89(mf) OTS
14954	16-10544	Dep.(nc); $1.10(fs), $0.80(mf) OTS
14956	16-10456	Dep.(nc); $1.10(fs), $0.80(mf) OTS
14964	16-11155	Dep.(nc); $1.10(fs), $0.80(mf) OTS
14965	16-9745	Dep.(nc); $1.60(fs), $0.80(mf) OTS
14965(App.)	16-9746	Dep.(nc); $14.00(fs), $6.32(mf) OTS
14969	16-10050	Dep.(nc); $3.60(fs), $1.16(mf) OTS
14971	16-10486	Dep.(nc); $1.60(fs), $0.80(mf) OTS
14972	16-9811	Dep.(nc); $1.10(fs), $0.80(mf) OTS
14977	16-10457	Dep.(nc); $1.60(fs), $0.80(mf) OTS
14984	16-10677	Dep.(nc); $1.60(fs), $0.80(mf) OTS
14985	16-10193	Dep.(nc); $1.60(fs), $0.80(mf) OTS
14992	16-9840	Dep.(nc); $1.60(fs), $0.80(mf) OTS
14993	16-10148	Dep.(nc); $1.10(fs), $0.80(mf) OTS
14996	16-10279	Dep.(nc); $3.60(fs), $1.34(mf) OTS
14997	16-9841	Dep.(nc); $5.60(fs), $1.79(mf) OTS
14998	16-9842	Dep.(nc); $3.60(fs), $1.16(mf) OTS
14999	16-9747	Dep.(nc); $1.60(fs), $0.80(mf) OTS
15000	16-9843	Dep.(nc); $3.60(fs), $1.37(mf) OTS
15002	16-9844	Dep.(nc); $1.10(fs), $0.80(mf) OTS
15003	16-10051	Dep.(nc); $1.10(fs), $0.80(mf) OTS
15005	16-10194	Dep.(nc); $9.60(fs), $3.65(mf) OTS
15016	16-10149	Dep.(nc); $8.10(fs), $2.72(mf) OTS
15017	16-9979	Dep.(nc); $1.60(fs), $0.80(mf) OTS
15018	16-9980	Dep.(nc); $1.60(fs), $0.80(mf) OTS
15019	16-9981	Dep.(nc); $1.10(fs), $0.80(mf) OTS
15021	16-9845	Dep.(nc); $1.10(fs), $0.80(mf) OTS
15032	16-9982	Dep.(nc); $16.50(fs), $7.73(mf) OTS
15069	16-10545	Dep.(nc); $5.60(fs), $1.94(mf) OTS
15072	16-10052	Dep.(nc); $2.60(fs), $0.86(mf) OTS
TM–	**(Misc.)**	
3323-67*	16-10537	See NP-11387
TR–	**(Misc.)**	
61-101.6	16-10485	See SEP-259
UCLA–		
500	16-10309	Dep.(nc); $1.60(fs), $0.80(mf) OTS
501	16-9812	Dep.(nc); $2.60(fs), $0.98(mf) OTS
UCRL–		
5430-T(Rev.II)	16-11053	Dep.(nc); $1.60(fs), $0.80(mf) OTS
5692	16-10150	Dep.(nc); $5.60(fs), $1.88(mf) OTS
5701	16-10964	Dep.(nc); $8.60(fs), $3.14(mf) OTS
5718	16-11021	Phys. Rev. 125: 955-63(1962)
5916	16-11339	Dep.(nc); $3.60(fs), $1.19(mf) OTS
5926	16-10678	Dep.(nc); $1.60(fs), $0.80(mf) OTS
5964	16-10216	Elec. Eng. 80: No. 2, 129-35(1961)
5967-T	16-11340	Dep.(nc); $1.10(fs), $0.80(mf) OTS
5973-T	16-9735	Dep.(nc); $1.10(fs), $0.80(mf) OTS
6048-T	16-10195	Dep.(nc); $1.60(fs), $0.80(mf) OTS
6259-T	16-10993	J. Inorg. & Nuclear Chem. 21: 15-20 (1961)
6433	16-9939	J. Inorg. & Nuclear Chem. 21: 188-9 (1961)
6543-T	16-10882	Phys. Rev. 125: 1088-93(1962)
6626	16-10679	Dep.; $0.50(OTS)
6652	16-10546	Dep.; $0.75(OTS)
6665-T	16-10151	Dep.; $2.00(OTS)
6669	16-11054	Dep.; $0.50(OTS)
6722	16-10134	Dep.; $0.50(OTS)
9584	16-10697	J. Chem. Phys. 35: 2186-92(1961)
9684	16-9756	See UCRL-9897(p.91-5)
9798	16-10855	Nuovo cimento (10) 22: 1087-92(1961)
9811	16-10878	Phys. Rev. 125: 1055-8(1962)
9813	16-9754	See UCRL-9897(p.66-83)
9897	16-9748	Dep.; $3.00(OTS)
9936	16-11077	Dep.(nc); $4.60(fs), $1.49(mf) OTS
9978	16-10888	Phys. Rev. Letters 8: 117-19(1962)
10001	16-10196	Dep.; $1.75(OTS)
UCRL-Trans.–		
476(L)	16-10160	$4.60(fs), $1.43(mf) JCL
774(L)	16-9955	Dep.(nc); $1.60(fs), $0.80(mf) JCL
782	16-9987	Dep.(nc); $2.60(fs), $0.89(mf) JCL or OTS
784	16-10820	Dep.(nc); $2.60(fs), $0.98(mf) JCL
USCEC–	**(Non-AEC)**	
79-101	16-11078	OTS
VDIT–	**(Swedish)**	
16.4	16-10622	Dep.(nc)
49	16-11156	Dep.(nc)
WADC-TR–	**(Misc.)**	
59-107(Pt.III)*	16-10197	OTS
WADD-TR–	**(Non-AEC)**	

Report No.	Abstract No.	Availability
60-872	16-11341	
61-72(Vol.IV)	16-10268	OTS
WAPD-	(Misc.)	
243	16-11157	Dep.; $1.00(OTS)
255	16-10623	Dep.; $0.50(OTS)
WAPD-T-		
923	16-10463	Corrosion 18: 45t-54t(1962)
1065	16-10940	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1182(Rev.1)	16-10395	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1235	16-11158	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1236	16-11159	$1.10(fs), $0.80(mf) OTS
1241	16-11160	Dep.(mc); $2.60(fs), $0.95(mf) OTS
WAPD-TM-	(Misc.)	
286	16-10396	Dep.; $2.25(OTS)
XDC-		
59-4-6	16-10624	Dep.(mc); $10.10(fs), $3.86(mf) OTS
XDCL-		
58-7-23	16-10487	Dep.(mc); $1.10(fs), $0.80(mf) OTS
60-6-710	16-10625	Dep.(mc); $3.60(fs), $1.31(mf) OTS
Y-		
1361	16-10436	Dep.; $1.00(OTS)
1377	16-10437	Dep.; $0.50(OTS)